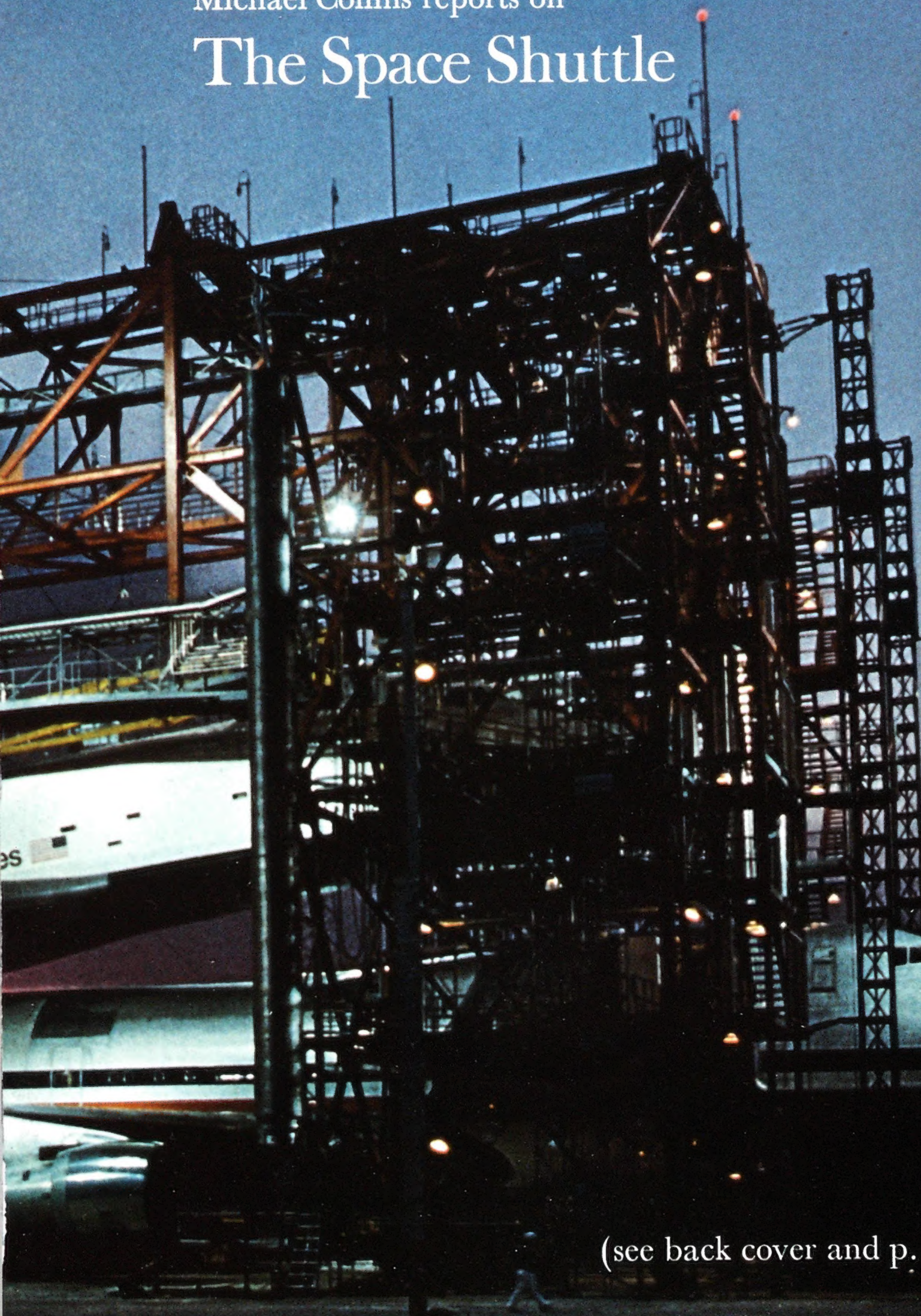
May 1977

Smithsonian

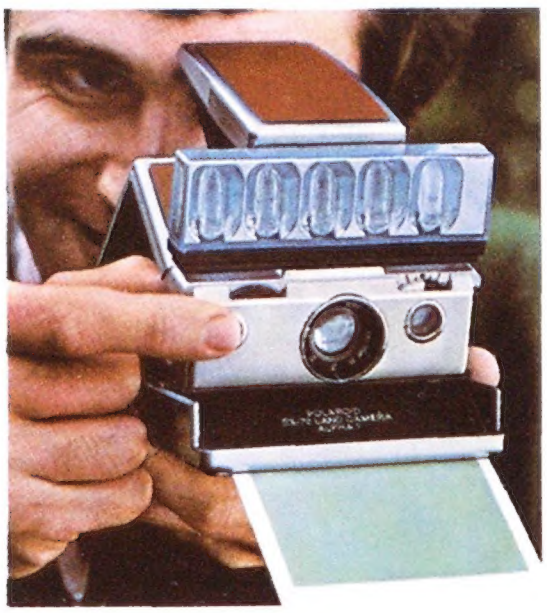
Michael Collins reports on

The Space Shuttle



(see back cover and p. 38)

How good is it? Decide for yourself.



Let's start with flash-in-daylight.

An SX-70 Alpha 1 Land camera got this picture in almost impossible light.

Our flash-in-daylight *balances* flash with daylight. You can shoot your subject against bright sunlight without silhouetting.

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Smithsonian

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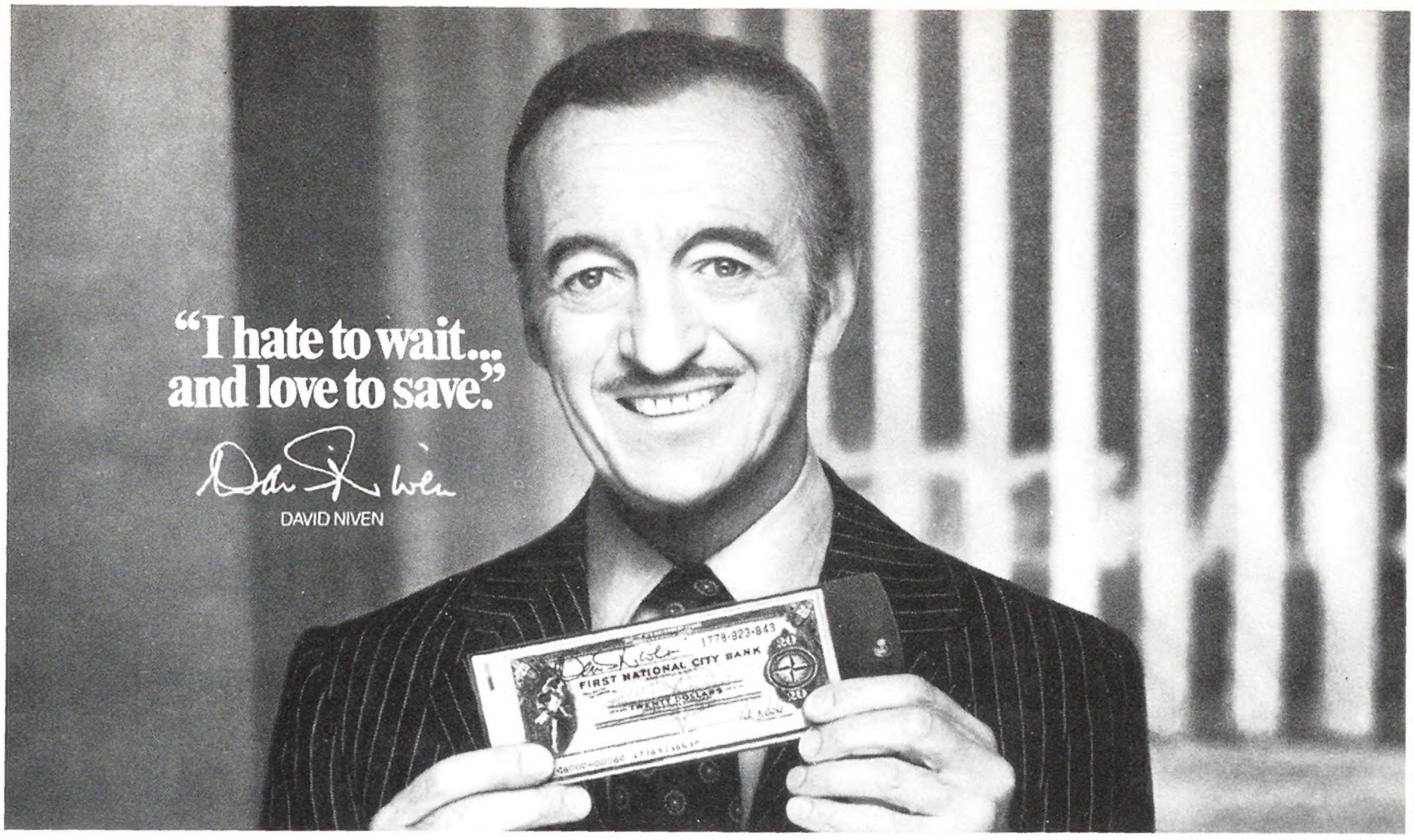

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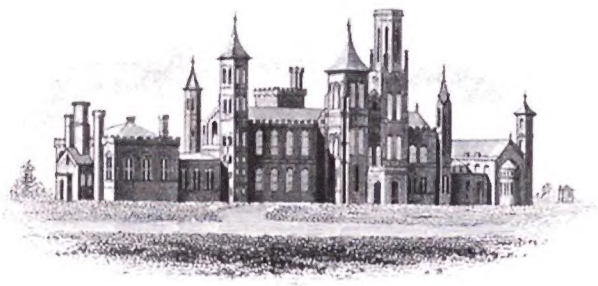
The view from the castle



When whales strand themselves on a beach,
Smithsonian scientists drop everything
to help—and try to discover why it happens

Fort George Inlet is a shallow, dish-shaped bay along the dunes of the Florida coast, 18 miles north of Jacksonville Beach at the mouth of the St. Johns River. On Sunday, February 6, a pod of short-finned pilot whales *(Globicephala macrorhynchus)* came in through the 65-foot-wide channel at high tide and soon appeared to be in trouble. A number of the animals forced themselves into shallower water in a giant semicircle around the perimeter beach. As the tide ebbed, it became apparent that another whale stranding was occurring, and everyone from casual tourists motoring along the coastal road to divers, Boy Scouts and a scientist or two, followed by eager members of the media, converged on the whales.

Groups of volunteers tried pushing some of the smaller creatures back into deeper water, only to see them turn and nudge their way back onto the sand. A number of the little whales, seemingly leaderless, circled about in the increasingly narrow channel of deeper water. The Florida Marine Patrol appeared, among whose ranks were several veterans of this curious phenomenon. A scientist was working waist-deep in the water, pushing and at the same time tagging some of the jittery creatures on the dorsal fin for future record. In the space of five or six hours, scores of whales were ushered back outside the bay.

Meanwhile those animals on the beach were still being rolled or pulled back into the water by groups of grunting volunteers or towed by Jeeps. Some of the large animals (pilot whales can reach a length of 12 to 18 feet and weigh more than 3,500 pounds) were being rolled from side to side every half hour or so to ease the stress on bodies designed for aquatic support, while dampened tarpaulins were spread over some of them to slow the drying of their skin. The dying animals gasped and some convulsively opened and closed their mouths, showing small, even rows of teeth.

Under the Marine Mammal Protection Act of 1972, the National Oceanic and Atmospheric Administration of the Department of Commerce has jurisdiction over the whales. NOAA is advised in this task by the Presidentially appointed Marine Mammal Commission. The Smithsonian Institution, by agreement with NOAA, has the responsibility for collecting whales that have died in strandings or other accidents, and has an active research program on these animals.

When Dr. James Mead of the Smithsonian's Museum of Natural History staff arrived, having marshaled a group of assistants and scientific colleagues from as far away as Canada, he set about measuring and taking tissue samples. Viscera, embryos (most of the whales in the pod and most of the dead were females and many contained fetuses), eventually brain and tooth samples —all would be taken for study. The phenomenon? "We may not know for 20 years," was all Mead would vouchsafe. Altogether, about 160 dead whales were counted along the coast from Florida to South Carolina between February 6 and 14. What a mystery, and will he solve it? Perhaps in 20 years we may understand the reason for these beautiful creatures' comings and goings, their lemminglike behavior on the world's beaches. Let us hope we find out while our oceans remain livable for all the denizens of the deep.

S. Dillon Ripley

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Start at the top. Cutty Sark is still blended and bottled only in Scotland. Somehow, the modern Scotch, bulk-shipped and bottled in America, isn't quite the same.

The centre of the label tells you that Cutty Sark consists of 100% Scotch Whiskies from Scotland's best distilleries. This produces that distinctive smoothness which is to be found in this blend alone.

Reading down, you learn that Cutty Sark was first blended at the direction of Berry Bros. & Rudd Ltd., wine merchants. People who, after 280 years of dealing with Royalty, have learned a little something about taste.

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It's the one in the dark green bottle with the bright yellow label that separates it from all the rest. The one that tells the greatest Scotch story ever told.

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UNITED AIRLINES

Letters to the Editor

The Lindberghs' primates

Dear Sir: Thank you for Rudolph Chelminski's article on the Lindbergh Verlhiac Primate Center in your March issue. It is refreshing to know that, while very rare, there are people like the Lindberghs. A lot of spiritual truth is yet to be learned from observations of the kind they are attempting to make.

I did a lot of primate medical research in former years and have kept primate orphans (as well as birds and other animals) for many years subsequently. Understanding the behavior, drives and instincts of these little fellows brings one closer to the "truth," and provides more understanding as to why Man almost invariably ends up so misguided.

Morris L. Newton M.D.
Texarkana, Texas

"Bush Negroes" in Surinam

Dear Sir: Of the several articles that have been written about our efforts in Surinam, Colin M. Turnbull's comes closest to our views. As he stated, we are *not* anthropologists but Afro-American scientists long denied a true picture of our past, who came face to face with one of the proudest chapters of black history. The profound inspiration taken from experience outweighs the technical data that we or other specialists have gathered.

When we have shared this experience (through our film) with other black Americans of all socioeconomic strata, many have been moved to tears. They usually ask questions, such as "Why haven't I known this?"

If we have contributed nothing else, we have informed a few thousands more Afro-Americans that slavery was not totally an experience of submission, suicidal outbursts, individual flight and subtle resistance. Those Afro-Americans militarily confronted their enslavers—and won!

S. Allen Counter
David L. Evans
Harvard University
Cambridge, Massachusetts

Versailles

Dear Sir: I was delighted to see my favorite picture of lovely Lady Bird Johnson —swirling gaily in her yellow and white gown—in the photograph on the table beside the Van der Kemps in their Versailles apartment.

Virginia Dare Ludwig
Tustin, California

The photograph of Lady Bird Johnson was taken during the White House years and given to her friends the Van der Kemps. Ed.

David Smith's sculpture

Dear Sir: John Russell's article, "David Smith's art is best revealed in natural settings," is very well written. However, it leads the reader to believe that all the works in the exhibition and illustrated in the article are the property of the Storm King Art Center.

We lent our Smith sculpture *The Letter* to the Storm King Center for their David Smith exhibition, but SMITHSONIAN illustrated it without our persmission.

Marjorie C. Freytag, Registrar
Munson-Williams-Proctor Institute
Utica, New York

We very much regret our oversight in failing to give credit to Munson-Williams Proctor Institute. We also regret our failure to credit The Guggenheim Museum for its Cubi XXVII. Ed.

Bananas

Dear Sir: After chuckling my way through William Breisky's article, "But yes, we had bananas—coming out of our ears," I found that his 31 tips reminded me of my childhood in Hawaii. Our various yards were always filled with banana trees and the nightly question at bedtime was: "Children, have you eaten your six bananas today?"

General Washington at Prayer

Announcing a Magnificent Commemorative to mark the 200th Anniversary of the Winter at Valley Forge (1777-1778). Sculptored by the renowned Laszlo Ispanky–hand cast by Royal Doulton. Sponsored by The Freedoms Foundation at Valley Forge.

IN the entire Revolutionary War, there surely is no moment more symbolic or significant than General Washington's silent prayer at Valley Forge.

Because in that terrible and heroic winter of 1777-1778, with Congress in disarray, the Colonies dissenting, and his army cold and starving, Washington had good cause to doubt the success of our Nation's struggle for freedom.

At the point of despair, the general sought a lone spot in the forest and, falling to his knees, prayed.

As he prayed Washington found new strength, faith and determination. He would press on, and the brave fight for freedom would be won.

Now, the Limited Editions Collectors Society of America is proud to announce a superb Limited Edition commemorative to preserve forever this solemn moment in America's history.

Sponsored by The Freedoms Foundation at Valley Forge, *General Washington at Prayer* has been sculptored by Laszlo Ispanky, one of America's foremost porcelain sculptors; and hand cast by Royal Doulton, the world's leading producer of fine porcelain figures.

Washington at Prayer by Henry Bruckner.
The inspiration for the magnificent porcelain which you may now possess.

Working from Bruckner's famous 1877 painting, the Ispanky masterpiece took two years, from concept to completion. Measuring 12" in height, the porcelain is a superb testimony to the sculptor's skill and painstaking attention to detail. It is an inspirational work and one sure to be sought after by serious collectors for many years to come.

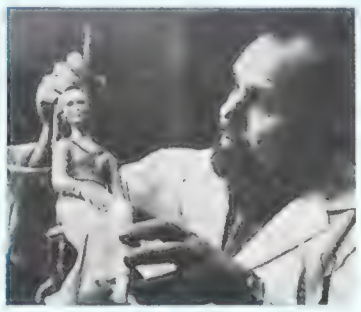
This official symbol of The Freedoms Foundation at Valley Forge *will appear on your owner's 'certificate of authenticity.' And your porcelain will bear a serial number entered in the Limited Editions Collectors Society's Master Registry.*

General Washington at Prayer. Issued in a strictly Limited Edition of 1777 pieces and fully authorized as the Official 1977 commemorative of The Freedoms Foundation at Valley Forge. Priced at $875.00.

Your investment is completely protected under the Warranty of both the Limited Editions Collectors Society of America, and Royal Doulton.

The beauty of the figure is further enhanced by a solid mahogany plinth, on which is displayed an authentic slice of the original 'Washington Elm.' It was beneath that famous elm, on Cambridge Common, July 3rd, 1775, that Washington took his oath as Commander-in-Chief.

To serious collectors of fine porcelain, Laszlo Ispanky is revered as 'The Living Master.'



America's foremost porcelain sculptor, Laszlo Ispanky, at work on one of his creations. His porcelains are to be found in many distinguished private collections and esteemed galleries throughout the world.

A noted work of Ispanky, 'Peace Riders,' is currently valued at $35,000.

Now, at a modest and most realistic price, you may own an original Ispanky issued in a Limited Edition of 1777. This is a rare opportunity to own a most fascinating work of art. A sculpture which captures a vital moment in the life of our Nation and of our First President, George Washington.

Complete and mail this coupon today to reserve your *General Washington at Prayer* porcelain. Deliveries are expected to begin early in July, 1977. Not available in stores.

To reserve the lowest possible serial number, call our toll free number 1-800-225-5252.

To: Limited Editions Collectors Society,
160 Old Derby Road, Hingham, MA 02043

Please reserve my General Washington at Prayer sculpture. I understand that serial numbers are assigned in the order in which either full payment or deposit is received and, upon final assembly, I will be billed the balance due, including shipping charges, prior to shipment. (Deposit required $100)

General Washington at Prayer. Priced at $875.00.
☐ Payment in full enclosed. ☐ $100 deposit enclosed.
☐ Charge full payment ☐ Charge my deposit.
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Another "trade" to add to his list was the discovery that a large bunch of almost ripe bananas on a piece of land we were in process of buying had suddenly disappeared. The next day we found a small puppy had been left behind in exchange for the missing bananas.

Chrisalis Woodruff
Pasadena, California

Dear Sir: The Breisky family with the oversupply of bananas should be put in touch with Lindberghs, the folks with the oversupply of "gourmandizing" monkeys. And when they meet, maybe Mr. Breisky, who speaks simply of "drying" his bananas, might tell Alika Lindbergh that SMITHSONIAN's copy editor owes her an apology for letting a misspelling of "desiccating" go through in quoting her about the effect of wind on the monkey's fur and skin.

Sidney S. Marshall
West Chester, Pennsylvania

American agriculture

Dear Sir: Maisie and Richard Conrat's article, "How U.S. farmers became specialists—in cash and debts," is a very dramatic and nostalgic look at the past.

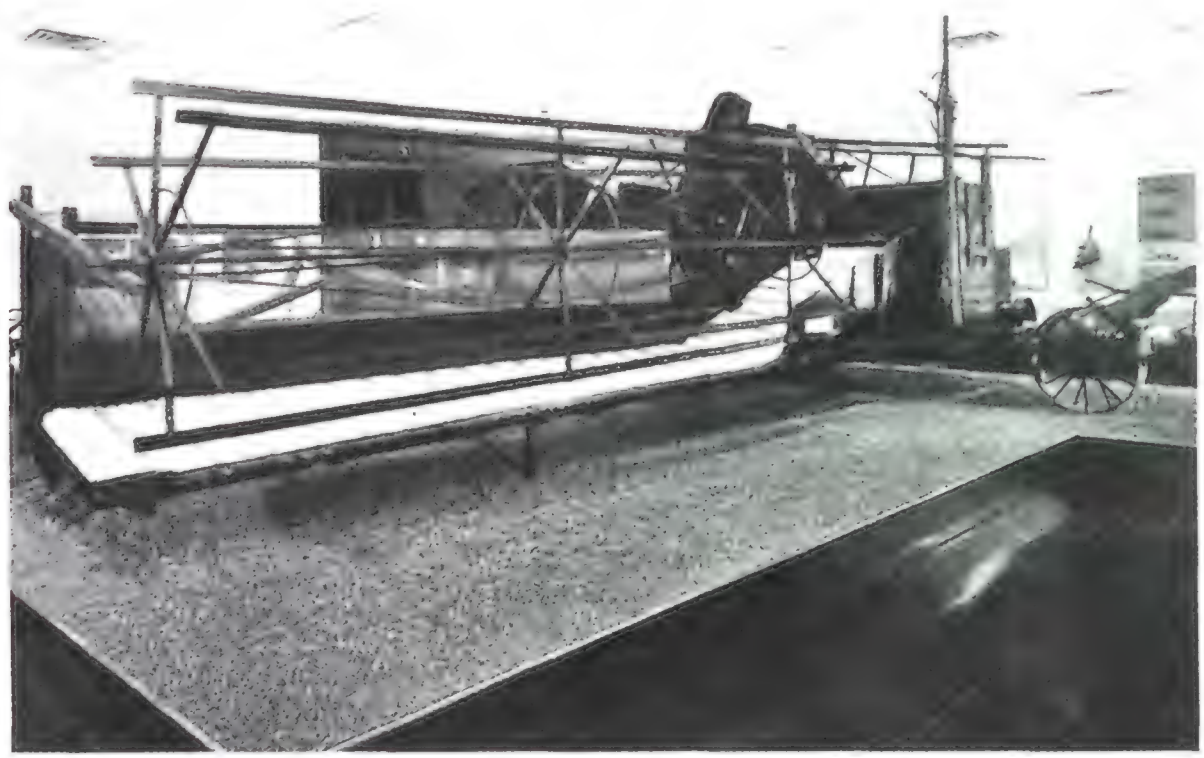
It reminds me of what an old lady told me of their early farming days in the San Fernando Valley in California at the turn of the century. She said that when they got their first combine, it was horsedrawn, but the great noise it made frightened the horses so that field workers were afraid they would break loose and bolt. Suddenly, the men had the happy thought of putting sleigh bells on the nearest horses, and after that there was no more trouble. The horses caught the spirit of the bells and steadied down.

Elizabeth D. Gardiner
Dedham, Massachusetts

Dear Sir: In my office I have the original photograph shown on the opening spread of your farm article. From this photograph, one of the five Holt combines was made into a postcard for the Smithsonian, and I have one addressed to my uncle, Benjamin Holt, President of Holt Manufacturing Company, Stockton California. It was mailed August 24, 1909, from Walla Walla, Washington.

Incidentally, a caption under the photograph of the combines is not quite accurate. In these combine harvesters the grain was not "bundled" as stated, but rather it was sacked—about 60 pounds to the sack—then sewn by hand and sent down a chute to the ground. Anyone interested in seeing one of these giant early wonders of the farm scene will find one displayed in the Museum of History and Technology's Hall of Farm Machinery [see below]. It was donated by my mother.

Harry D. Holt
Holt Bros.
Stockton, California



This 1886 combine was built by Benjamin Holt, who later invented the Caterpillar tractor.

How to shop for bonds

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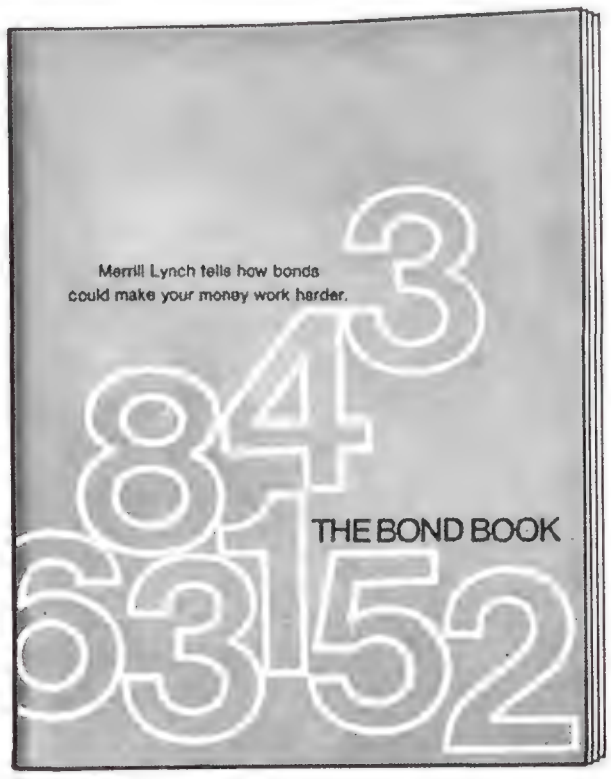

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8 Explores capital gains possibilities. See pp. 32-33. Reveals surprising ways you can invest in bonds for capital appreciation—as well as income.

9 Explains price fluctuations. See pp. 7-8. Shows how and why bonds fluctuate in price.

10 Contains charts, case histories. Illustrated throughout. With 19 helpful charts and diagrams. 8 simulated (but typical) case histories. 3-page glossary of key terms.

11 Shows how to use leverage. See pp. 32-33. How to get over three, even four, times the cash equivalent value of bonds. Discusses profit potential of doing so—and risks.

Besides being a good introduction to the bond world, The Bond Book is an excellent reference—whenever you want to "look something up."

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Encounter austria

I played Chopsticks on Beethoven's piano

It was in the house at Mölkerbastei 8 in Vienna, where the composer lived for many years. It's a museum now dedicated to his memory. I looked at the piano where Beethoven worked and I began to play it in my mind. I chose the only work I ever really learned! Being in the master's home, in this glorious city of music, gave me a feeling I can't describe in words. And my rendition of Chopsticks doesn't say it either.

Beethoven lived in Vienna, and Beethoven still lives here along with Strauss, Haydn, Mozart, Schubert and so many others. My mother was right. I should have practiced harder...

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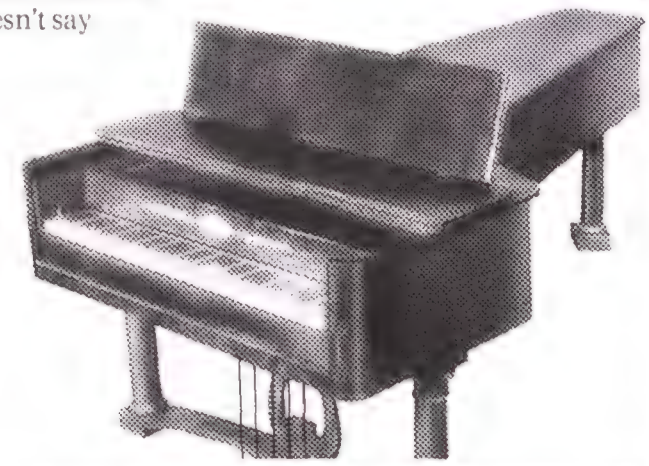

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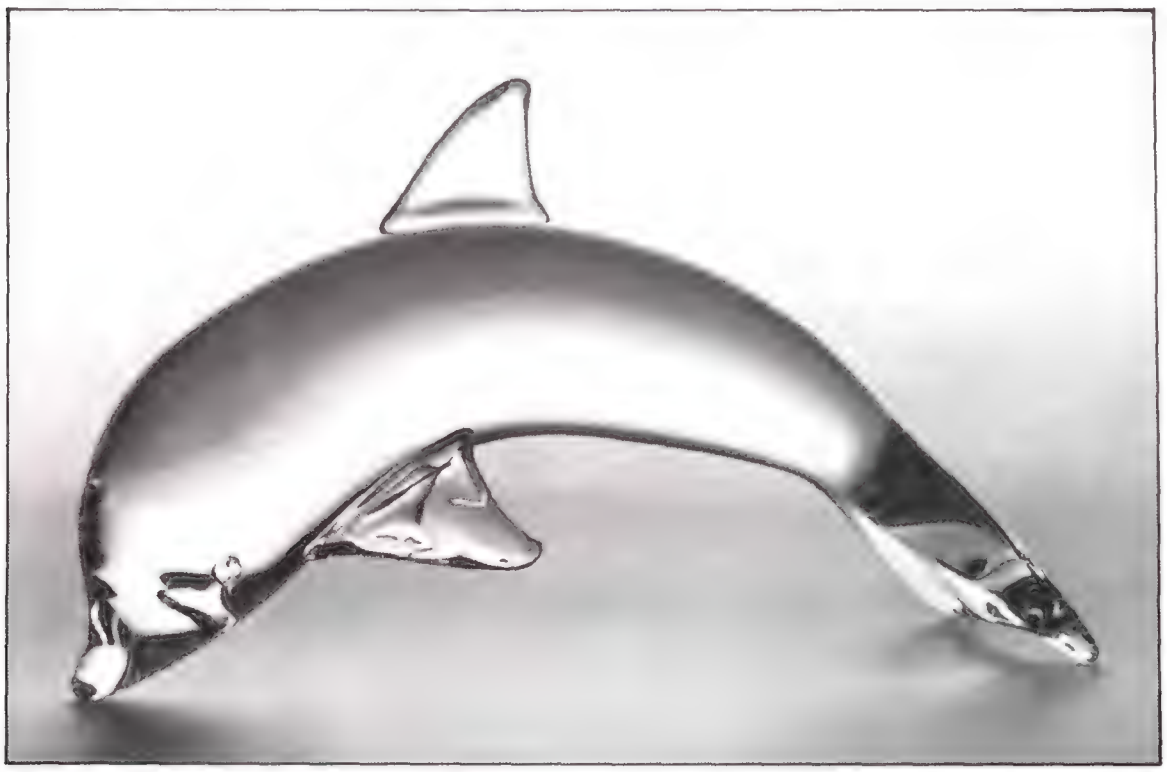

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Silver Hill Museum

Dear Sir: In connection with the item in Edwards Park's column, "Around the Mall and beyond," we would like to add one more detail for visitors who may wish to go to the Silver Hill Museum. Tours are by reservation only on Wednesdays, Saturdays and Sundays at 10 A.M. and 2 P.M. Tours last approximately two hours and provide a view of some 40 aircraft and a variety of objects from the Smithsonian's astronautics collection. Reservations should be made two weeks in advance. Telephone (202) 381-4056, or write to the address below.

R. Lynn Bondurant
Education Officer
Presentation and Education Division
National Air and Space Museum
Smithsonian Institution
Washington, D.C. 20560

Dr. Mary Walker

Dear Sir: How refreshing, after a long Bicentennial year of hearing of men's achievements, to read an article on the dedicated, determined Dr. Mary Walker.

Author Allison Lockwood should be strongly encouraged to be equally dedicated to exposing more of the interesting creative energies of 50 percent of our population. I look forward to reading articles about Alice Paul (see SMITHSONIAN, November 1972), Belva Lockwood, Antoinette Brown, Elizabeth Stanton, Susan B. Anthony, Lucy Stone and others!

Kendra Wagner
Evanston, Illinois

Dear Sir: One small detail in your account of that colorful personality, Dr. Mary Walker, disturbs me. She should be referred to as a suffragist, not suffragette. The suffragettes were the militant Pankhurst faction in England. In the United States such crusaders as Susan B. Anthony, Lucy Stone, Anna Howard Shaw and Carrie Chapman Catt were suffragists.

A. Elizabeth Taylor
Professor of History
Texas Woman's University
Denton, Texas

Professor Taylor is correct, but the two are often used interchangeably. Ed.

Dear Sir: Anne Walker, great-grandniece of Dr. Mary Walker, recently expressed an interest in S. J. Res. 33, a resolution

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Three different views of a single work of art from the Treasures of Tutankhamun—a 3,300-year-old solid gold statuette of the young king at about the age of nine. The original statuette is one of fifty-five works of art in the exhibition, "Treasures of Tutankhamun," organized by the Metropolitan Museum and now touring the United States.

Tutankhamun wears a royal headdress, the Blue Crown of Upper Egypt, and a pleated kilt with an ornamental apron suspended from a girdle which is engraved with his royal name in hieroglyphs. The figure, 3½ inches high, surmounts a staff of gold which may have been used at the king's coronation ceremonies. It was found between the two outermost shrines which protected Tutankhamun's mummy, wrapped together in fine linen with a virtually identical one in solid silver.

In November of 1975, eight members of the Museum technical staff went to Egypt. The results of their efforts are evident in the seventy-five full color plates of the catalogue of the exhibition ($6.95) and the more than one hundred extraordinary copies of Tutankhamun's treasures: the first truly accurate, rather than approximate, reproductions of these incomparable works of art.

Copies of the statuette of Tutankhamun may be purchased from the Metropolitan Museum by mail. Illustrated above: Solid pewter surfaced with gold ($17.00). Also available in sterling silver and in a limited edition of 500 in solid gold.

IDE7

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Senator Edward W. Brooke introduced, recommending restoration of the Congressional Medal of Honor to Dr. Walker.

At the time, Senator Brooke commented that he felt that Dr. Walker "is truly worthy of retaining the . . . Medal. . . . During the Civil War, Dr. Walker served as an unsalaried physician in the Union Army, during which time she treated soldiers at the battles of Bull Run and Gettysburg and, at the risk of capture, she crossed enemy lines to care for destitute Southern civilians near Chattanooga who were suffering and in serious need of medical attention." The Senator added, "I hope the Congress will act favorably."
Mary Claire Langille
Staff Assistant to Senator Brooke
United States Senate
Washington, D.C.

Additional reading

Dear Sir: For the benefit of your U.S. readers, please note that *The Physiological Clock* by Edward Bünning is not only distributed in England but is also published by Springer-Verlag New York, Inc.
V. Borsodi
New York City

Abominable Snowman

Dear Sir: Mary Hamman's account of her expedition into the Himalayas in search of the Abominable Snowman was greatly enhanced by Rosi's photographs.

Since his photograph shows no navel, it is obvious that this is a picture of the original Yeti. If it had been a picture of one of its offspring, a navel would have been in evidence.
Richard T. Dole
Greenwood, Nebraska

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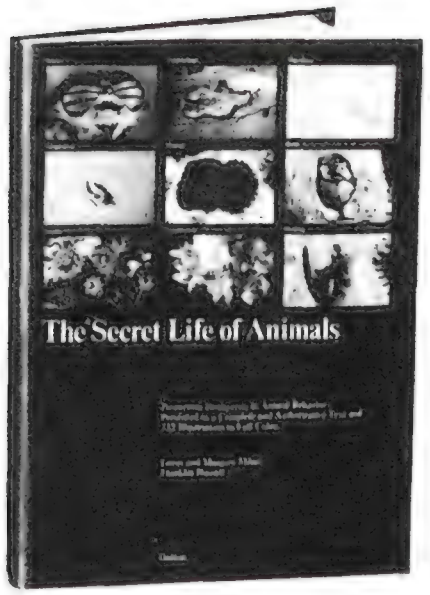
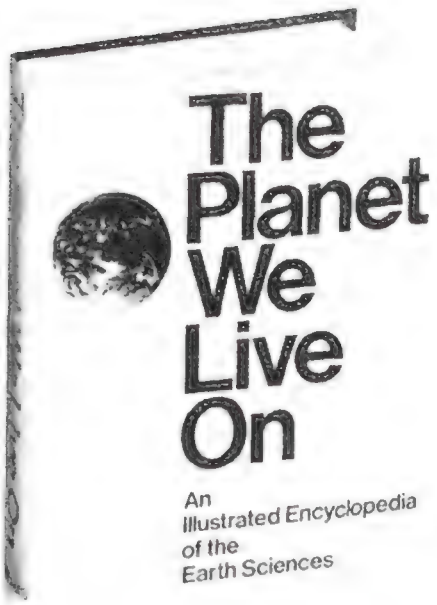
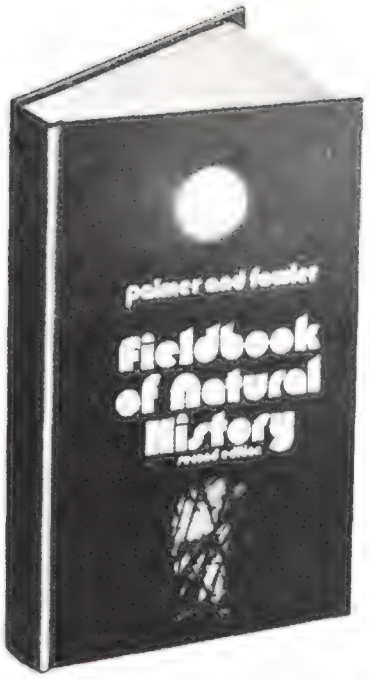
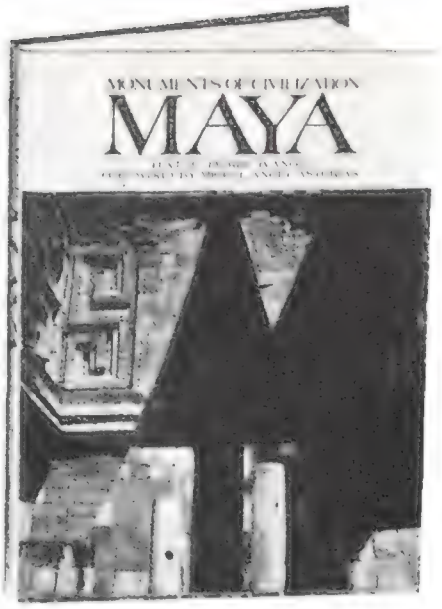
Cover Christopher Springmann; 12 Capsco, Inc.; 31 Smithsonian Institution; 36 T. Weber Greiser; 38-44 Christopher Springmann; 45 NASA; 47 Christopher Springmann; 48-55 Paul Breeden; 56-61 Schopplein Studio; 64-70 Arthur Shilstone; 74-76 William A. Garnett; 77 Neil Folberg; 78-81 William A. Garnett; 84 Los Angeles County Museum of Art; 86 Julian Wasser; 87, 88 Los Angeles County Museum of Art; 89 Julian Wasser; 90-91 Los Angeles County Museum of Art; 94 *The Thousand Buddhas* by Aurel Stein; 95 courtesy Dr. Gustav Steiner; 96-98 *Ruins of Desert Cathay* by Aurel Stein; 100-101 *The Thousand Buddhas;* 102 *Ruins of Desert Cathay;* 103 *The Thousand Buddhas;* 106-115 E. Richard Sorenson; 116-117 Sven-Olaf Lindblad; 118 Kent and Donna Dannen; 120-121 M. Philip Kahl, Jr.; 122 Tomas D. W. Friedmann, 124 Leonard Lee Rue III (116-124 all Photo-Researchers Inc); 144 Roz Schanzer.









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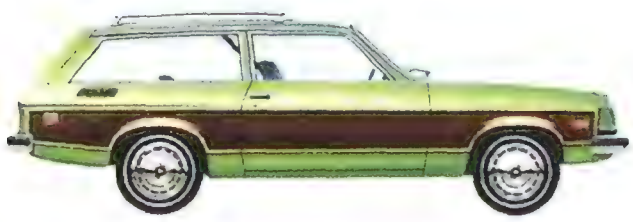

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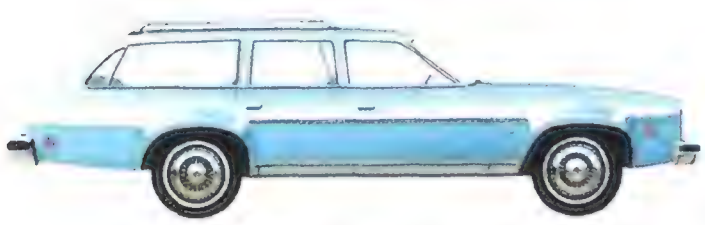

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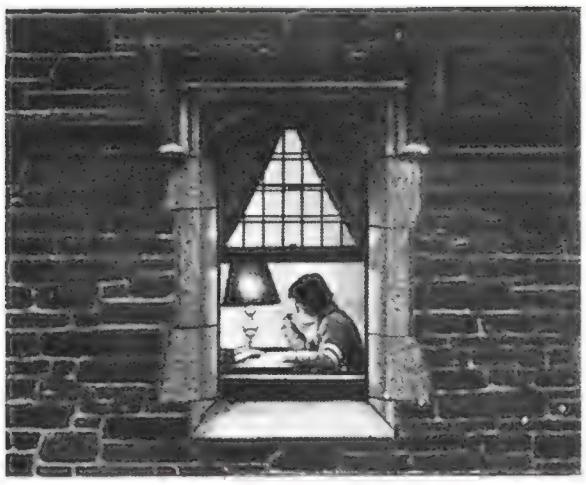

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3. Winners will be determined in random drawings from among all correctly answered and eligible entries conducted by V.I.P. Service, Inc. an independent judging organization whose decisions are final, and will be notified by mail.
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Phenomena, comment and notes

Oil from these ubiquitous, worn-out treads, the perils of zinc-poor blood, and the advent of bionic eyes

No doubt those people who giggle at the esoterica of scientific research had a good laugh when, several decades ago, people began to look into the question of how bats get around. But bat research has had an unforeseen payoff. A New Zealand professor, after intensive study of bat echolocation, has devised an ultrasonic system whereby blind people can "see" by using sound.

The device is a headset that beams ultrasonic sound into the environment and converts the echoes into audible sound. A high pitch means a distant object, low pitch means a near one. Large objects are heard as loud, small ones as soft. Even texture can be discerned by the clarity of the signal. The sound is stereo, so direction is also perceivable.

Adults have found the device extremely difficult to use—perhaps, Dr. Tom Bower of Edinburgh University suggests in *New Scientist* (Volume 73, No. 1037), because adults show less ability to coordinate their senses, such as sight and hearing, than do babies. Dr. Bower tried out the device on a 16-week-old blind baby who almost immediately was able to track moving objects with his head and eyes, even hitting them with his hand.

Yet another technological fix may be in the offing. Researchers at Utah University have been able to "convey dynamically changing patterns to a blind volunteer by direct electrical stimulation of his visual cortex." This was done by implanting a grid of 64 electrodes mounted in a Teflon mesh inside the volunteer's cranium.

The subject, a 33-year-old man blind for ten years from a gunshot wound, went to the laboratory and was connected to an outside source of electronics. Whenever small currents of electricity passed through the implanted electrodes, he could visualize flashes of light called phosphenes, which varied in size, color and intensity. When varying patterns of electrodes were stimulated, recognizable "Braille" cells were formed. As the Braille characters were generated, the volunteer could read 30 characters a minute.

In another experiment at Utah, a tiny television camera was used with electrodes and a computer system in such a way as to allow the subject to see vertical and horizontal stripes on a black background. The hope is that such experiments eventually will permit the blind to "see" images.

The researchers look ahead to the time when 256 electrodes can be implanted, hooked up via dummy spectacles to a glass eye which would itself contain an array of light-sensitive semiconductors. With such a device, the blind would be able to move about freely and read essential signs.

The Six-Million-Dollar Man is no joke.

Tire power

Worn-out automobile tires, of which the United States generates 200 million each year, have always been an intractable problem. Buried, they tend to emerge from the earth, intact and intransigent. Tied together, weighted and hurled into the sea, they make attractive "reefs" for

She danced for the first time at the Maryinsky Theatre in St. Petersburg in 1890. The Princess Aurora, Tchaikovsky's Sleeping Beauty, the masterwork of 19th century Russian choreographer Marius Petipa.

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sea life to flourish around, but obviously the local sea, even with the 200-mile limit now established, can accommodate only so many new reefs.

An answer is in sight, according to *Technology Review* (Vol. 79, No. 3). An organization called Occidental Research Corporation has experimented with grinding tires into bits and retrieving their constituents: oil, char and gaseous light hydrocarbons. The economics of the process appear excellent, says Occidental, so long as grinding costs stay down, but radial tires almost certainly will raise those costs.

Another solution is simply to burn the tires, which is what Goodyear Tire & Rubber is doing. They feed 130 tires (3,100 pounds) per hour into a special furnace and produce process steam. Each tire is equal to 2.5 gallons of fuel oil. So, arithmetic tells us, if we could round up all the tires and build enough furnaces, we could reclaim the equivalent of five billion gallons of oil each year.

Submarines and birds

The requirements of submarine warfare have led to an interesting insight into the matter of bird navigation. In order to communicate instantly with its submarines in the event of a nuclear attack, the U.S. Navy has hoped to place, in Wisconsin or Texas, a huge underground system of radio antennas and transmitters, according to *Esquire* (April 1977).

Once called Project Sanguine, the scheme was rejected by the locals as being environmentally unsound, and so a scaled-down version, called Project Seafarer, is being examined at the Navy's Wisconsin Test Facility. There a suspended antenna creates a low-frequency alternating-current magnetic field. Researchers from Rockefeller University were interested in what effect this field would have on migrating birds as they passed through it.

Recently it has been established clearly that birds can detect direct-current fields, such as the Earth's magnetic field, but little work had been done on alternating current and on low-intensity fields.

Tracking birds by radar and recording their changes in flight path near the antenna, Ronald P. Larkin and Pamela J. Sutherland found that some birds indeed can detect low-intensity fields within seconds and, as they write in *Science* (Vol.

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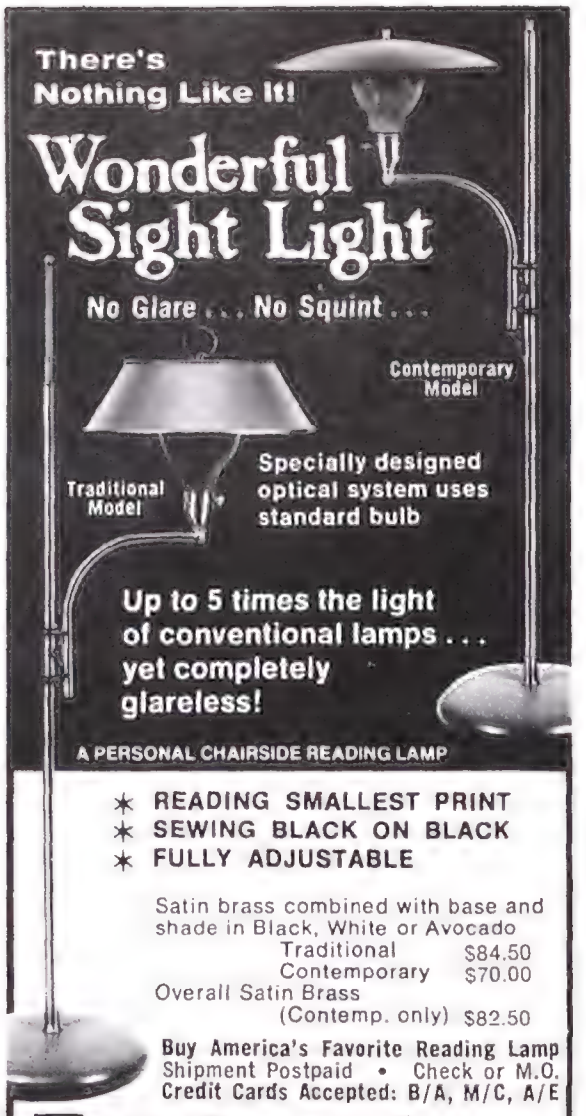
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195, No. 4280), "may make use of local . . . magnetic features of the earth's surface in migration and orientation."

As if that weren't marvelous enough, other researchers, at Cornell University, have found yet another way by which birds may navigate around the globe: they may also detect atmospheric infrasound. And if you have never heard of atmospheric infrasound, it stands to reason because it is inaudible to the human ear.

Apparently wind, thunderstorms, weather fronts, auroras, earthquakes and such phenomena generate low-frequency acoustic waves. The Cornellians beamed sounds of an amplitude within the same range as atmospheric infrasound into the cages of homing pigeons and, through a complex series of measurements of heartbeat, determined that the birds can detect and respond to such sounds.

Writing in *Nature* (Vol. 265, No. 5596), the researchers point out that atmospheric infrasounds can travel thousands of miles, and that migrating birds might be able to "use" them to detect approaching weather fronts.

So now we have evidence that birds can use the stars, the Earth's magnetic field, local magnetic variations and the infrasounds of the atmosphere to make their incredible journeys. This being May—by its name a permissive time of year—perhaps a layman can be allowed an analogy: birds may be something like really good sailors.

To those of us who occasionally and ignorantly serve as crew on a sailboat captained by an expert, sailing is an equivalent mystery. The old salt knows where he is going and how he will get there not just from compass readings and charts but also from the feel of the winds, from the set of the sail, from a sense of the boat's balance received through the tiller, and from unexplainable patterns of wavelets that tell him of tides and other agents affecting his course. To the ignorant ballast called crew, it is all incomprehensible in the same sense that bird navigation will always be just beyond the ken of us nonbirds.

Possibly that kind of magic is why some people become ornithologists.

The benefits of zinc

A few years back, the scientific rage was to find how excesses of heavy metals in

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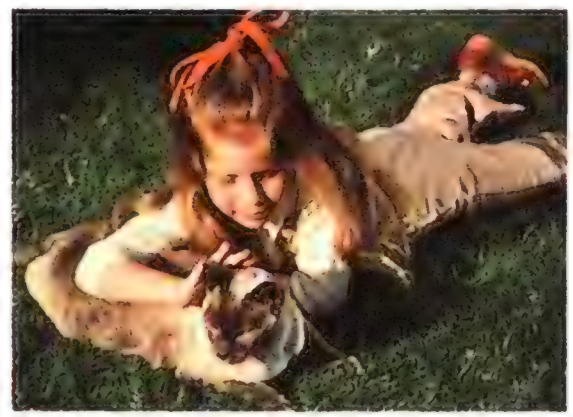

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the environment were harmful to our health. While many of these findings have properly found their way into environmental regulations, the scientific rage now is to find how insufficiency of certain trace metals in our bodies is harmful to our health.

Take zinc. It is developing a considerable pharmaceutical repertoire, according to *Medical World News*, which covered a recent zinc conference in Fort Lauderdale, Florida (Vol. 17, No. 28; Vol. 18, Nos. 1 and 3).

American babies apparently have lower levels of zinc in plasma and hair than those in some other countries, probably because the zinc level is lower in commercial baby formulas than in cow's and mother's milk. Researchers in Denver raised the zinc in formula from 1.8 milligrams per liter to 5.8. After six months, zinc-enriched babies had, on the average, grown more than one-and-a-half centimeters more than the controls and were some 400 grams heavier.

Since then, some formula makers have added zinc to their product and doctors have been advised to consider zinc deficiency in cases of children who have poor appetities and lagging growth.

Too little zinc is also implicated in bacterial prostatitis. Normal men have nearly nine times more zinc in their prostatic fluid than those afflicted. But zinc apparently does not always go where you want it to: oral doses of zinc raised serum levels of the metal in the blood, but not levels in prostatic fluid.

Not just an antibacterial agent, zinc apparently plays a key role in the body's immunity response generally, but researchers have not pinned down precisely the biochemical blueprint and are cautious about recommending a high zinc-level regime for everyone.

One group who, it seems, *will* benefit is the tragic sufferers from sickle cell anemia. There is some evidence that a regimen of zinc acetate reduces the frequency of episodes of pain, and some inconclusive evidence suggests that it retards the sickling activity of the blood cells, perhaps by retarding their uptake of calcium (which has been tentatively implicated in the onslaughts of this genetic condition).

In sum, it all appears highly promising, but in need of further research. And just when did we hear *that* before?

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There is no button to press since the display glows in the dark. A glass ampoule, charged with tritium and phosphor and sealed by a laser beam, is placed behind the new CDR (crystal diffusion reflection) display. When room lights dim, the self-contained tritium light source will compensate for the absence of light by glowing brightly and illuminating the display.

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The Laser 440 is only 8 millimeters thick—thinner than many of the so called thin digitals being advertised today. The new CDR display draws 100,000 times less current than an LED watch when displaying the time so your single commercially-available Union Carbide battery lasts years longer. In fact, part of our warranty includes all the batteries you'll ever need, free of charge, for five full years. To replace a battery, simply open up the battery hatch on the back of your watch, tap out the old battery and drop in the new one.

Most digital watches have dozens of electronic components. The Laser 440 has only six—two integrated circuits, a crystal and three microcapacitors. All components are bonded directly on the printed circuit board. By hermetically sealing the integrated circuits and using fewer components, the Laser 440 is considerably more reliable than other watches that do not yet have this complete integration.

The new Sensor Laser 440 digital watch glows in the dark so there's never a button to press to read the time in darkness or in sunlight.

THE ULTIMATE ACHIEVEMENT

Other manufacturers have devised unique ways to produce a watch you can read at a glance. The $300 LED Pulsar requires a snap of the wrist to turn on the display, but the Pulsar cannot be read in sunlight and its display uses 100,000 times the current of the Sensor display. The $400 Longine's Gemini combines both an LED and liquid crystal display. (Press a button at night for the LED display, and view it easily in sunlight with the liquid crystal display.) But you must still press a button to read the time. All these applications of existing technology still fail to produce the ultimate digital watch: one you can read under all light conditions without using two hands. Until the new Laser 440.

And if you've owned a digital watch for a year, chances are you've had it in for repair more than once—a very common consumer complaint. The Laser 440 is so service-free and has such high quality that it should rarely, if ever, require service. It is backed by a solid five-year warranty—your assurance of our commitment to this outstanding new product.

The Laser 440 has both time and stop watch functions. Six digits are on display—four large digits and two small ones. You choose between hours, minutes and seconds or hours, minutes and date by pressing a button. The Laser memory remembers the number of days in a month and resets automatically on the first day of the new month.

The 440 is also available in an 11 function chronograph (stop watch) and is truly the ultimate Laser timepiece. You can time two separate laps of a multilap race keeping one lap in memory. You can accumulate time; you can view the time of one lap while continuing to time a lap stored in memory. As a business executive, you can time long distance phone calls and interviews. Lawyers can keep track of their services, and doctors can time the vital signs of their patients. Even while the chronograph is functioning, you can still view the time—something even many of the expensive digital chronographs cannot do.

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The Laser 440 is ideal for pilots because of its cockpit visibility and chronograph functions, perfect for the businessman who depends on his watch for split-second accuracy and the ultimate watch for anybody who wants unquestionably the finest digital watch ever offered at any price.

The Laser 440 is not only thin but is designed to conform to the contour of your wrist. A bulky digital watch can become annoying to wear—especially if you have a thin wrist.

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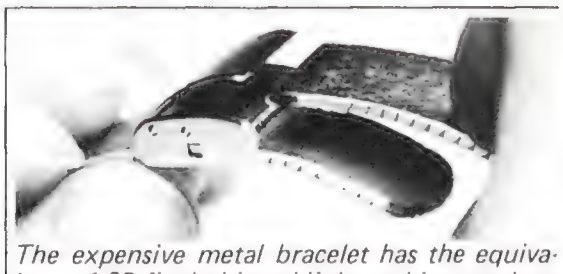

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Around the Mall and beyond

Alex Haley, author of *Roots*, came to the Smithsonian in the dead of winter to give one of the Doubleday lectures. I was warned, fortunately, to arrive early for the event. The lectures usually draw two or three hundred people, but this one was besieged by about a thousand listeners, vying genteelly for every available folding chair that the Museum of History and Technology could scrape together.

I copped one of the last empties at the end of an aisle, remembered my gentility long enough to ask if it was taken and was informed by a straight-backed gentleman that it was all mine. He then introduced himself—Benjamin Davis—and the lady beside him—Mrs. Nettie Washington Douglass. The names percolated, and after a question or two I firmly established who my neighbors were: General Davis, commander of the black 99th Fighter Squadron of World War II and later of the 332nd Fighter Group, segregated outfits that the Army Air Forces reluctantly allowed to exist and then watched in pride and wonder as their pilots swept the skies over Italy; and Mrs. Douglass, a descendant of Booker T. Washington and whose husband is similarly descended from the powerful black abolitionist of Lincoln's time, Frederick Douglass. Talk about roots!

Alex Haley autographs *Roots*.

Mr. Haley spoke about his search for his origins. I suppose he has given this talk scores of times—in fact, a record was released recently dealing with this quest—but he is a sincere and emotional man who cannot get into this subject without revealing the shattering impact it had on him. Consequently, you can't listen to him without absorption, without deeply shared emotion. As he talked about his acceptance by his distant cousins in that distant village of his ancestors, I found an unashamed lump in my own throat, and, when he touched on the generations of enslavement, I found myself staring down at the floor to avoid looking at General Davis and Mrs. Douglass. I was suddenly aware, with bitterness, of my own color. There is a white man's burden, all right, and I felt its weight unbearably at that moment.

A long, long line formed after the lecture: people carrying sometimes two or three or more copies of *Roots* for Haley to autograph. Such success indicates more than the self-searching of American blacks. To me it seems to reveal a new curiosity about all our American beginnings, the interest in origins that the Institution fostered with the "Kin and Communities" project of the Bicentennial year (Around the Mall, SMITHSONIAN, April 1976). Wilton Dillon, Director of Symposia and Seminars, who dreamed up "Kin and Communities," is happy to agree that he foresaw the stampede.

Wilton Dillon reminds me that there will be a symposium next month dealing with and largely consisting of the American family. It will be chaired by Margaret Mead (who will bring along at least one member of her family), and will include Mrs. Jimmy Carter who will be surrounded by some of the Carter family. The symposium opens June 14 at the Eisenhower Theater of the Kennedy Center in Washington.

Many automobile buffs have written to learn more about the hydrogen-powered car that appeared in the Inaugural parade—the vehicle I did *not* describe in this column last March. The fact is, the

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Smithsonian has maintained considerable interest in hydrogen power and has been looking into it with interest. Most of the pioneering in hydrogen engines comes out of Provo, Utah, where the Billings Energy Research Corporation has several hydrogen cars and buses.

As a fuel, hydrogen has advantages over gasoline. It's more efficient, according to the Billings people, and far from being a noxious effluent, the exhaust of an H_2 engine is, if anything, somewhat cleaner than the outside air. It is also relatively easy (although costly) to convert gasoline or diesel engines to hydrogen.

On the other hand, the best way to store this volatile gas so far seems to be as a hydride—a compound in which it is joined with a powdered iron-titanium alloy. The metallic mixture sops up hydrogen and holds it until heat is applied.

The trouble is that the hydride system, as it's called, is heavy. To get any mileage out of a hydrogen engine, the tank of hydride must be big. Then it weighs the car down. So the likeliest use of the fuel at present seems to be in vans and buses.

Work is continuing at Provo, of course, for ideally we have a limitless source of hydrogen to tap: all the Earth's water. Electrolysis can produce the gas, but so far the process is difficult and expensive. Possibly, as one scientist told me, the best use for hydrogen would be on a huge industrial scale, replacing coal in steel and iron works, for example. This would free existing carbon fuels to be converted to gasoline or electricity.

The 50th anniversary of Charles Lindbergh's flight will be duly recognized here late this month with a symposium in the Air and Space Museum. Behind all this, however, many memories will stir about the late General and his extraordinary achievement. Some of our oldtimers at the Air and Space Museum recall Lindbergh's visits there.

Sometimes he had a special reason. The old story goes that in 1952, when he was writing his second book about the flight, *The Spirit of St. Louis,* he asked for a ladder so he could climb into the cockpit of the original *Spirit* as it hung in the Arts and Industries Building. Paul E. Garber, now Historian Emeritus of the Air and Space Museum, fulfilled the request, and, after the visitors had gone for the day, Lindbergh shinnied up to his old plane and crawled inside. He had been

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writing about fuel consumption during the famous flight to Paris, and he wanted to check some marks he had penciled beside his gas gauges far out over the Atlantic. They were still there 25 years later. They're still there now.

Lindbergh took some notes and then stayed inside for a while, all alone in the area except for Garber down below. Finally he poked his head out the open door and called down to Garber that he was ready to leave. Garber, sitting quietly below in the empty and silent hall, thinking of other things, suddenly heard this voice calling him from Lindbergh's plane. He looked up and saw Lindbergh's face peering out of it. Strange.

Lindbergh was an old friend of Paul Johnston, a former Director of the Air and Space Museum, back in those days. And one of the young assistant curators of that time now recalls how he would sometimes have to go out into the parking lot to meet the General and lead him back to Johnston's office. Lindbergh would show up, tall and grave and quietly courteous, and on the way through the museum would invariably stop for a moment under his old plane and look up at it. He wouldn't say anything. Then when he reached the outer room of the Director's office, he would always take the time to go over and shake hands with each of the receptionists and stenographers and other office helpers: "My name's Charles Lindbergh; how do you do?" The small courtesy would always knock them out.

Sometimes Lindbergh would be taken to a special place in a gallery beside the plane—a place closed off to tourists—and then he would be left alone, a tall, gentle person, looking at the machine that so utterly changed his life in May 1927.

A lot of people think of Smithsonian scientists as being sort of button-down in appearance and "Eastern establishment" in outlook. So when I watched a film over at the Museum of Natural History about tracing the settlements of our earliest Indian "immigrants," I rather expected this. I got, instead, Dennis Stanford.

Dr. Stanford wears pearl-buttoned cowboy shirts that may or may not be buttoned down. You can't tell, because that part goes under his beard. He doesn't wear a tweed jacket with leather elbow patches. He wears faded denims. He doesn't smoke a pipe. He tucks a bit of

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Dennis Stanford, right, on a dig.

snuff under his lip. He was born in Iowa and reared in Wyoming. He went to the University of Wyoming and the University of New Mexico.

Stanford's techniques in the field are somewhat different, too. He has been tracking down the life of the Paleo-Indians of some 10,000 years ago by seeking their stone, wood and bone tools and the remains of the animals—mammoths and extinct big-horned bison *(Bison antiquus)* in North America and mastodons and camels in South America.

To prove to himself that an ancient Indian could butcher a bison with a bone tool, Stanford finds a dead calf in Colorado, hacks off a leg bone with a sharp stone, then breaks and shapes the bone into a cutting tool. He uses the same sharp stone implement to do this and finds that it leaves the same marks and fractures as those that appear on the bone tools of 10,000 years ago. Then he butchers the calf with the tool. He figures that if he can do it, so could a Paleo-Indian.

On the other hand, Stanford is a pretty basic guy who probably can do a lot of Paleo-Indian things that many of us might find awkward. He can talk cattle prices with ranchers, hunkering down in the dust and passing the snuff, and so earn enough respect to be allowed to dig up a piece of rangeland. He's entered rodeos. Personally, I'd find that both Paleo-Indian and awkward.

Stanford's work is being financed by the National Geographic Society. Right now, since it's May, he's getting ready to get back into the field—the life he loves.

—Edwards Park

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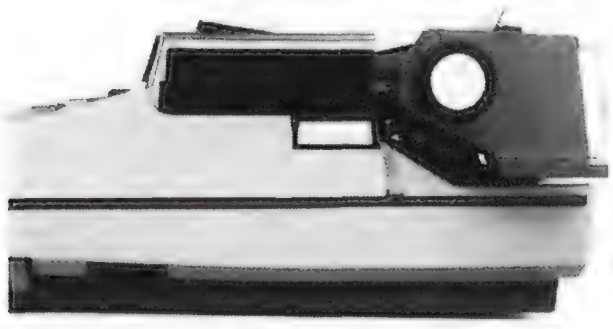

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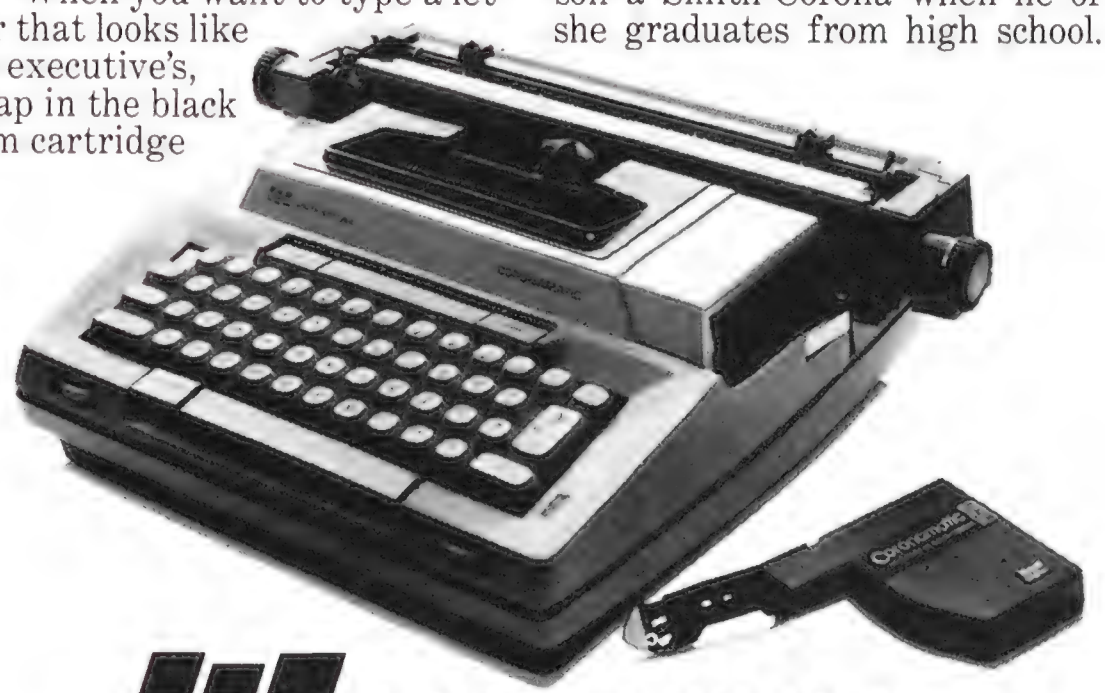

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By Michael Collins

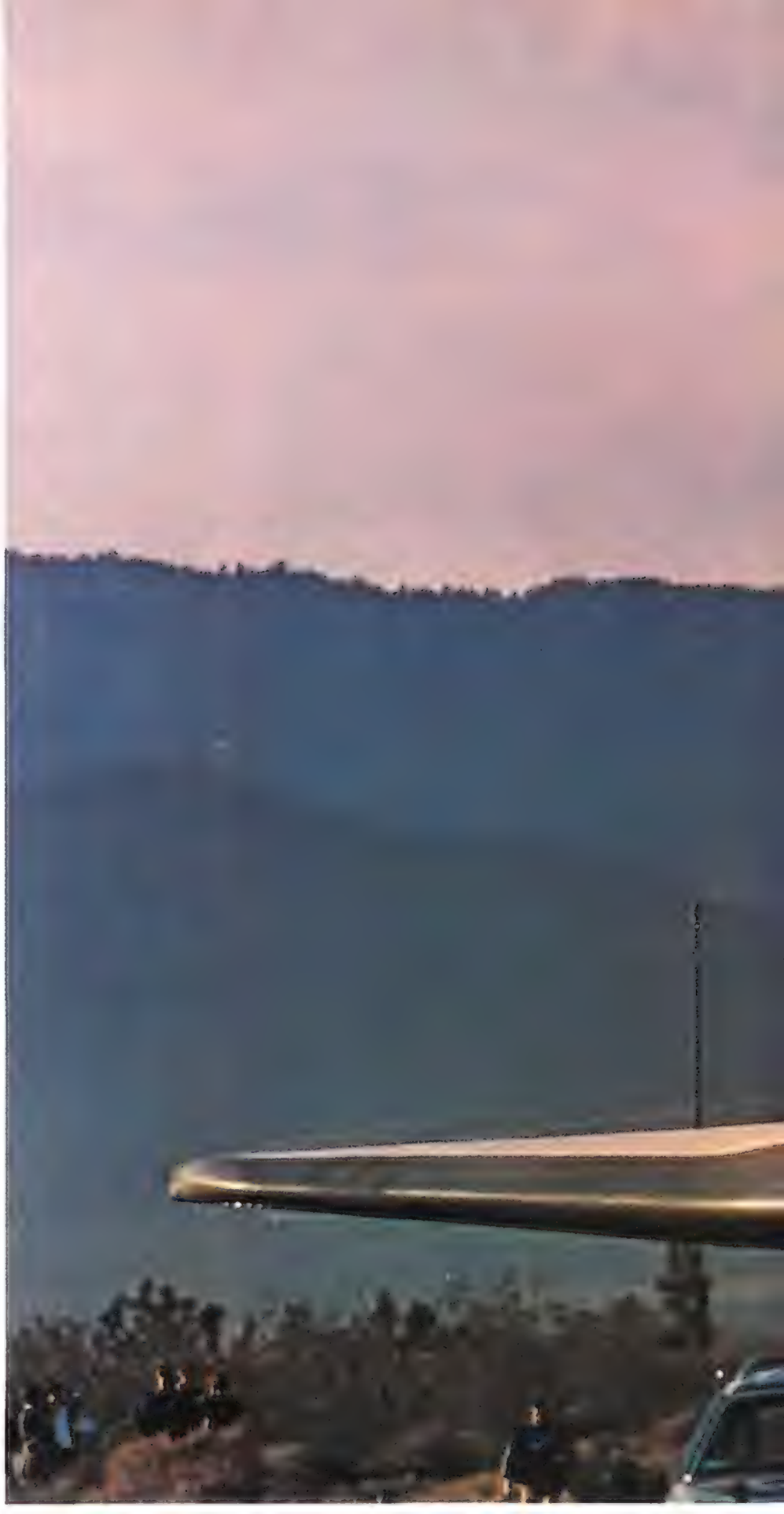
Orbiter is first spacecraft designed for shuttle runs

NASA's "flying brickyard," the DC3 of space, ushers in a new era of routine servicing of satellites, manned labs

When I was a kid reading Buck Rogers, the spacecraft all looked like bullets or saucers, with sweeping fins and fancy tail skids. The real thing turned out to be more prosaic, but as Phase I of the space era winds down and Phase II begins, perhaps we are beginning to see Buck's dream emerge in the squat but elegant space shuttle, NASA's "flying brickyard."

The shuttle, also known as the orbiter, rockets into orbit but glides back to Earth. Proponents claim it will usher in a whole new era of routine space operations. Critics say it's unnecessary. Designed to be the country's space workhorse for years to come, the shuttle is a fascinating combination of old and new concepts, at once daring and conservative in design.

The basic idea behind the shuttle is simple enough: a craft that can be used over and over again, instead of falling into the ocean and being discarded, as rockets are. An early shuttle design featured a two-stage vehicle, each with a human crew. When the first stage ran out of fuel, it released the second, which continued its climb into orbit while the first returned to land on a runway. This concept was abandoned, primarily because of high initial cost, and the manned first stage was replaced by a pair of gigantic solid-propellant rockets. These rockets will fall into the sea when empty, as their predecessors have done, but they will descend via parachute and be recovered for use again.



The shuttle will continue under its own power, three rocket engines churning away—using fuel stored in a huge external belly tank that will be discarded before the ship reaches orbit. The principle of recycling has not been followed completely, since the external tank is lost. But the shuttle itself can make as many as a hundred flights between overhauls.

The first orbiter, Serial Number 101, was rolled out

Mr. Collins, command module pilot of Apollo 11, wrote a popular book on space flight and now directs the Smithsonian's Air and Space Museum.

Orbital propulsion pods bulging like compound eyes of a giant insect, *Enterprise* creeps at four mph behind NASA escort toward Edwards Air Force Base. Forty-mile trip took ten hours, delicate maneuvers.

of its hangar at Palmdale, California, on September 17, 1976, amidst great fanfare. Senator Barry Goldwater blessed it, as did Olin (Tiger) Teague of Texas and a bevy of other politicians, bureaucrats and community leaders. NASA had intended to name 101 the *Constitution,* but the White House got so many letters from *Star Trek* fans that the name was changed to *Enterprise* in honor of Captain Kirk's starship.

The orbiter is generally described as about the size of a small jetliner, which is true in terms of length and width, but it is much bulkier and far more complex than any aircraft ever built. It must carry equipment needed not only to navigate and maneuver in space, but also to survive the searing heat of reentry into the atmosphere. In addition, the shuttle must be able to glide back to a safe landing, decelerating from an orbital speed of 17,000 miles per hour to about 180 knots as it touches the end of the runway. The rules of flight

Photographs by Christopher Springmann

change radically as the craft passes from one aerodynamic regime to another. The complex sweep of the orbiter's delta wings and the exaggerated height of its vertical tail indicate the designers' concern about its ability to maneuver successfully from the hypersonic through the supersonic into the subsonic range.

Beneath its skin one finds equipment common to both airplanes and spacecraft. The flight controls, for example, are a combination of aerodynamic and reaction control systems. Above the atmosphere, maneuvering must be done by firing small rocket motors; in the atmosphere, conventional rudders and elevons are employed. In the middle speed and altitude range, during reentry, rocket and aerodynamic controls must be skillfully blended. The pilot is aided in this task by sophisticated computers, which decide just how much to move the control surfaces or how long to fire the rockets in order to change direction. Without them, the orbiter might lurch out of control into a hypersonic spiral from which the pilots could not recover before the craft exceeded its structural or thermal limits. The computers also perform a host of other chores, from keeping track of the fuel supply to remembering the orbital parameters of satellites that the crew may need to inspect or repair.

The orbiter needs electrical and hydraulic power, just as conventional jetliners do, for operating landing gear and flaps, but here electricity is provided by three lightweight fuel cells that use liquid hydrogen and oxygen, as in the Gemini and Apollo spacecraft. Hydraulic power is provided by ordinary pumps, but space temperatures are so low that the fluid must be heated or it will freeze in the lines. The cabins of airliners are pressurized so that passengers may breathe, but in the vacuum of space the orbiter must carry its own air supply.

The crew will be comfortable in their shirt sleeves, breathing 20 percent oxygen and 80 percent nitrogen at a pressure of 14.7 pounds per square inch—conditions like those we enjoy at sea level. The cabin of the orbiter will be quite similar to that of a jetliner, with pilot and copilot sitting side by side; seats behind them are provided for a mission specialist and a payload expert. Underneath this flight deck is a compartment with room for six additional seats, so that a total of ten people can be accommodated if required for a rescue mission. The crew can be as few as two, for the early test flights, or as many as seven, including scientific and technical people to care for a variety of payloads. A typical mission will stay in orbit a week, but

Hi-ranger takes pilots out of space freighter, permits easy inspection of the ceramic underbody.

Space freak today, crew member tomorrow? NASA policy is to encourage women to volunteer for training.

Blankets and high-priced coffee keep technicians warm in predawn preparations for initial test flight.

Mating procedure completed, shuttle and Boeing 747 await inspection with almost lordly equanimity.

Posterior view of shuttle in Mate/Demate fixture shows massive vertical and horizontal control surfaces.

Shuttle must use directional rockets in orbit; rudder, elevons in atmosphere. Computers aid the pilots.

if extra supplies are provided it can be stretched perhaps to 30 days.

The orbiter's bay is huge by present space standards, stretching for 60 feet along the fuselage. Clamshell doors swing outward to provide easy access to the 15-foot-wide cavity. The bay can handle cargo loads up to 65,000 pounds, some of which can be jockeyed around by the crew with manipulator arms. Two people at a time, protected by space suits, can inspect or repair payloads.

Satellites are very much a part of our daily lives, giving us ringside seats at the Olympics, tracking hurricanes, monitoring missile firings, identifying potential oil-bearing formations, seeking out subsurface water, mineral deposits and earthquake fault zones, and helping us predict the volume of spring runoff by calculating the accumulation of snow in the mountains. Satellites can pinpoint sources of pollution, chart ocean currents, show where deserts are spreading and identify some crop diseases. But they must also be extraordinarily reliable, because they cannot be repaired or retrieved once in orbit. In the future, shuttle crews will be able to bring them back to Earth for repair. Thus, the shuttle will allow us to perform tasks which heretofore have been too expensive with one-shot expendable boosters and payloads.

Zero-gravity experiments

The European Space Agency is producing a cylindrical spacelab, tailor-made to fit into the orbiter's cargo hold. It will accommodate as many as four scientists for a month of varied astronomical observations, physical and chemical experiments under zero-gravity conditions, and complex studies of the medical effects of prolonged weightlessness on the human body.

The Earth's atmosphere blocks out most of the electromagnetic radiation coming to us from the rest of the universe. After centuries, earthbound astronomers are increasingly anxious to break through this semi-opaque screen. Optical, infrared and ultraviolet observations aboard the shuttle and spacelab could begin in the near future.

How much does NASA expect to save with a reuseable vehicle? The real cost of a launch depends mainly on how one amortizes the initial research and development, but NASA recently has told potential foreign and commercial users to expect a price tag of approximately $20 million per shuttle mission, while U.S. government users will pay $17 million per flight. By comparison the shuttle's chief competitor, the Air Force's Titan III rocket, costs $46 million per launch, yet carries a substantially smaller payload.

Potential users, primarily the Department of Defense, were asked to list their needs for the Eighties

Seldom in recent times has such an ungainly hybrid taken to the skies, then flown so gracefully.

Odd couple touch down without incident. At 75 tons, orbiter weighs less than a 747's normal payload.

and Nineties. The results of this survey indicate that approximately one launch per week should suffice, assuming the shuttle replaces all expendable boosters with the exception of the lightweight Scout. NASA would like to see more launches, which would reduce the unit price, and the Department of Defense foresees a need for some additional capacity in the 1983-91 period. But, Defense asks, what happens if they want to get a satellite up in a big hurry? Will NASA drop everything else to meet their needs? What happens if some defect turns up that grounds the five-shuttle fleet? What about sabotage? Shouldn't Defense keep an independent launch capability for emergency use? NASA wonders if the nation can afford to keep a redundant launch capability that might never be used. The total cost of designing and building the shuttle fleet and putting it into service is now estimated at $9.5 billion.

As a former astronaut and test pilot, however, it's not financing the shuttle that really interests me, but flying it. Although it won't go into orbit until 1979, its glide tests will begin this summer at Edwards Air Force Base, California. The *Enterprise* will be carried aloft by a Boeing 747 jumbo jet and released at 22,000 feet. For the first five of these flights, the orbiter has been modified slightly from its space configuration; a special streamlined tailcone has been added to reduce aerodynamic drag and improve glide characteristics. With the tailcone, flight time from release to touchdown is about five minutes. Without this device, the orbiter glides like a skipping stone and stays aloft only two minutes. The last three test flights will be without the tailcone. Another modification for the early tests is the addition of two ejection seats; accordingly, the crew will be limited to two. During the brief moments after they are freed from the 747, the pair will earn their pay, going through a fast-paced but elaborate series of maneuvers to measure the subsonic handling qualities of this 150,000-pound glider.

Dead-stick landing at 180 knots

With very little margin for error, and with no chance to compensate for a serious goof, the last 60 seconds of the shuttle test flights will be exciting indeed. Coming down at an angle of ten degrees with the tailcone on or 22 degrees with tailcone off, and a speed of about 240 knots, the pilot aims for a point just short of the runway. When he reaches approximately 1,500 feet above ground he starts to flatten the glide path to 1.5 degrees, creating a stress 1.7 times the force of gravity. At no less than 300 feet, he lowers the landing gear. His craft is now decelerating rapidly as it crosses the runway threshold and approaches the selected touchdown point. As indicated, landing speed will be 180

Artist's conception of 1979 Kennedy blast-off. With twin boosters and aluminum belly tank, this will be NASA's most complex launch configuration.

knots when the orbiter is empty, slightly higher when it is carrying a load. All this with no engine power to correct for mistakes!

A power-off glide to a precision landing is not quite as death-defying as one might imagine, however. With computers to help, both on the ground and aboard the orbiter, the pilot will know whether he is on the proper glide path. Corrections back to the ideal path can be made by varying airspeed, making S turns or using the speed brake. Completely automated landings, with no help from the pilot, will be possible ultimately, even under the worst weather conditions.

After the *Enterprise* leaves Edwards in 1978, two years of ground tests will measure system stresses under simulated flight conditions. In March 1979 the second orbiter, as yet unnamed, will be first to venture into space with human beings aboard from Pad 39 at Kennedy Space Center, the old Apollo moon-launch site. Again a crew of two, sitting in ejection seats, will be employed.

In former times, putting men aboard a test vehicle that had never been in space would have seemed daring. But NASA is more confident now than in the days of Saturn V. Without crews, both flight sequences would have had to be automated, including the tricky reentry and landing at Edwards. The idea of an unmanned test orbiter zooming in from the Pacific and zipping over southern California at 1,700 miles per hour made planners a little edgy.

The airplanelike shape of the orbiter, its external belly tank and the two solid rocket motors combine to create the most complex configuration ever rocketed from Kennedy Space Center. This lack of symmetry puts an extra burden on the shuttle's control systems during launch, for as it gains speed and its wings produce more lift, it will tend to veer off, so it must be pulled back into line by swiveling the rocket engines to the opposite side. As it passes the speed of sound, the orbiter's shock waves will interact with those produced by the external tank and the solid rockets.

Predicting what will happen then is more of an art than a science, but it is believed no dangerous vibrations or oscillations will result. If they do, the crew can probably eject to safety. If the shuttle is going to act up, we hope it will do so early in the flight test program, because after the first four flights from Kennedy Space Center, out come the ejection seats, and in goes the normal crew of four or more. Then they will be at the mercy of the solid rockets, for once they ignite the crew has no choice but to hang on for the ride. After the solids burn out at an altitude of 25 miles, the crew can turn around and head back to Kennedy if things don't look right. This arrangement makes an old pilot like me nervous, but solids have a very good safety record, and a low altitude abort capability may be simply an outmoded vestige of the early days of space flight.

Previous manned reentry vehicles have controlled thermal buildup by shedding tiny chunks of incandescent heat shield. The orbiter has no shield of this type, but its belly is protected by semipermanent silica-coated ceramic blocks designed to radiate heat back into the atmosphere. Their checkerboard finish gives the orbiter the bizarre look of a flying brickyard.

Who will fly this strange craft? Initially, the same group of astronauts and test pilots we have become familiar with over the years. Commander of the first drop test at Edwards will be Fred Haise, who limped back from the moon aboard Apollo 13 after its oxygen tanks exploded. The captain of the second Edwards test will be Joe Engle, veteran of a dozen X-15 hypersonic research flights. The first orbital crew has not yet been picked, but they probably will be familiar names. Beyond that point a newer generation doubtless will begin to emerge.

NASA has realized that it needs more crew members and has issued invitations for both pilots and mission specialists to apply, but no later than July 1, 1977. The agency is looking for young, well-educated, highly motivated specialists, male or female, to usher in Phase II of America's adventure in space. The machine they fly certainly will be different, combining such daring features as a manned first launch and a power-off landing with the more conventional aircraft systems. It sounds so promising and so much fun that maybe even a broken-down former astronaut or two will slip application papers into the pile.

Access tower awaits next phase, a free-flight test of glide characteristics scheduled this summer.

By Robert E. Arnold and Laer Pearce *Illustrations by Paul Breeden*

Burgeoning cult of wild food nourishes fatal misconceptions

Fearless foragers roam the countryside in search of tasty tidbits, blithely ignoring dangers that lie all about

In the millennia before agriculture developed, the ability to forage for edible plants was a major dividing line between hunger and a full stomach, long life or quick death. The earliest humans depended largely on plants for their diet, so botanical taxonomy became Mankind's first serious study. Being able to find tasty plants was important, but so was the ability to recognize poisonous ones, a knowledge that not only helped good foragers survive, but speeded the evolution of Man's analytical and observational skills.

The word "toxic" can be traced back to an expression meaning "arrow poison," and Man was using toxic roots, stems and leaves to poison his prey long before he learned to grow crops. As society became more complex, poisons often were employed against human adversaries as well. One of the earliest medical records, the Ebers Papyrus of about 1500 B.C., detailed many of the toxins used by the ancient Egyptians, and in the Golden Age of Athens it was a cup of hemlock, not the spear or the gibbet, that killed society's dissidents and undesirables.

In the Middle Ages there was a figurative explosion of knowledge about toxic plants and, perhaps inevitably, a vast increase in the number of poisonings. Deadly elixirs decocted from fruits, leaves and roots became known as "succession powders," and expert poisoners were in great demand to dispatch kings and commoners, bishops and laymen, rival merchants and philandering lovers. Women were especially fond of poisoning their enemies, since it was unladylike to fight duels. Field experiments were introduced in the 16th century by Catherine de Médicis, Queen of

All toxic, in varying degrees: jequirity beans (opposite), widely used for necklaces and rosaries; apple seeds; peach and apricot pits; and castor beans (bottom), the old-fashioned garden favorite.

Legendary "destroying angel," *Amanita phalloides*, kills or permanently incapacitates careless collectors.

France, who tested her wares by delivering poisoned food baskets to the poor. Carefully noting the effects, she was able to refine her Gothic art and produce ever more effective concoctions.

The great epoch of poisons came to a close when overt homicide became more respectable. Today the ubiquitous handgun is the mode of choice and deliberate poisoning is out of fashion. Perhaps more important still, we are no longer an agricultural society. We do not understand, study or work with plants. Certainly the common man has forgotten what his ancestors knew about poisonous plants. Modern Americans don't even realize that toxic plants are growing all around them. Such plants are not confined to the woods, meadows and creeks of the wilderness—they're growing in alleys, along fences, in vacant lots and even inside our houses.

Today nature is a welcome escape from the tensions of urban life. With the growing popularity of hiking, camping and rock climbing, the number of people foraging for edible wild plants is increasing apace. Also increasing, unfortunately, are hospital admissions of people who feast on wild *inedible* plants. Even if armed with Euell Gibbons' humorous and informative guidebooks, the average modern forager would do well to respect his own ignorance and eat with all deliberate caution.

Imagine the Sunday hiker, vade mecum in hand, heading into the forest to gather a free, vitamin-loaded supper. The first find is a pretty one, a patch of graceful mushrooms. Even though a succulent mealtime delicacy such as a morel would be a terrific find, mushrooms pose a particular threat to the inexperienced because edible and poisonous mushrooms often grow side by side and can look remarkably alike.

The telltale signs of the textbooks—rings around the stem or the way the cap and the stem meet—actually tell little. In its short life a mushroom can change shape, consistency and color, so even experts have difficulty identifying many subspecies. Fatal mistakes can be made. For centuries, the sudden appearance and rapid decay of mushrooms have made them a symbol of the ephemeral, but few beings, plant or animal, will lead briefer lives than the collector who mistakes the *Amanita phalloides* (above) for an edible mushroom. This fungus is so famous for its lethal effects that it is commonly known as the "destroying angel"; it can kill from 50 to 90 percent of those who eat it and can leave many survivors with permanent liver damage and shorter life expectancy.

Mushrooms in hand, the "wild vegetarian" now hunts for something to serve with them. Luckily he comes across some wild parsnips. He fails to notice that the roots of the wild "parsnips" are not single, but multiple, and joined at the top. This is a mistake he will not repeat, because what he has harvested is water

Arnold, a Kentucky surgeon and outdoorsman, writes a regular column on poisons for Field & Stream. *Pearce, a former newsman, is a free-lance writer who specializes in medical and related subjects.*

Wild parsnips, a gustatory delight—until gourmand realizes he has partaken of deadly water hemlock.

If birds and animals eat it, then it's okay for people, right? Wrong! Moonseed only resembles grapes.

hemlock (*Cicuta* species, above), one of the deadliest biota on Earth. Water hemlock is found in stream beds and swamps throughout the United States, including Alaska and Hawaii. The plant's thick, fleshy roots are tempting, but just a few bites can polish off a healthy adult. In fact, it is estimated the plant kills 30 percent of those who ingest it.

Poison hemlock (*Conium maculatum,* p. 55) shares a name and a bad reputation with water hemlock, but the similarity ends there. The two plants are not in the same genus, and their poisons work in different ways—water hemlock causes convulsions and poison hemlock kills by paralysis—but both are famous destroyers. Poison hemlock was introduced to this country from Europe and now grows along roadsides and in city dumps in most states. It was an aristocrat in the past, however: its most famous victim was Socrates. The forager may mistake its leaves for parsley or its seeds for anise—both of its parts definite no-no's.

Poke (*Phytolacca americana*) has long been welcome on menus since its shoots, young tender leaves and stems are delicious, but poke is a plant that requires great care in cooking. One must not include the toxic roots with the stems, and the latter must be thoroughly cooked. Raw or inadequately cooked leaves can be harmful, and ingestion of more than ten uncooked berries can cause serious poisoning.

For a beverage to wash down the feast that awaits him the amateur may decide on a nice woodsy tea. Among the leaves in the area are monkshood (*Aconitum* species), which contains aconite, a favorite arrowtip poison of the ancient Chinese; sweet-smelling mountain laurel (*Kalmia latifolia*) and rhododendron, both of which contain andromedotoxin, used by the Delaware Indians to commit suicide; and the Kentucky coffee tree (*Gymnocladus dioica*), which has cytisine in its leaves, a toxin that causes diarrhea, vomiting and even coma. To give his tea a little extra flavor, an innocent may mix in some wild cherry leaves, which he thinks have medicinal properties. The fruit is usually safe, but the rest of the tree, especially the leaves and seeds, contain cyanide. Large amounts of these parts of any of the *Prunus* species, which includes wild cherry, chokecherry and southern mock orange, can be fatal.

As a final course, and a final example of the hazards of botanical naiveté, an intrepid and indefatigable searcher picks some wild grapes. Now, wild grapes can

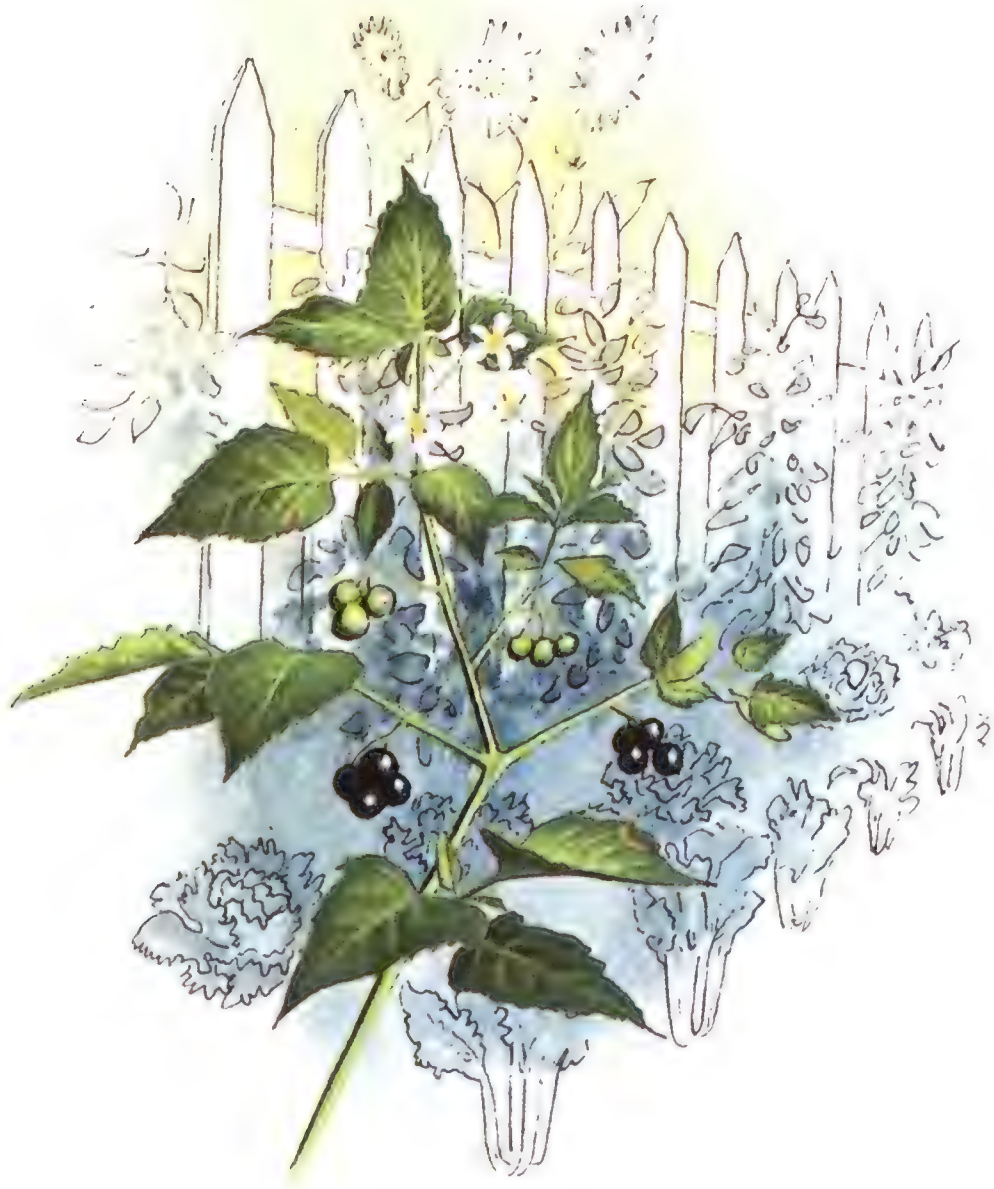
Dieffenbachia, the mother-in-law plant, is a popular houseguest but can cause death by suffocation.

During Parthian campaign *Datura stramonium*, jimsonweed, gave coup de grace to Roman armies.

be a juicy treat. But if perchance the forager gathers the similar-looking moonseed instead (p. 51), he will get his deserts, just or unjust, rather than dessert. Moonseed defies the folk wisdom that if birds and animals eat a plant, it must be safe. Birds in fact do eat moonseed with no ill effects, but humans cannot tolerate it.

In the course of his walk in the woods, the wild food enthusiast may also encounter some plants that don't have to be eaten to be dangerous. Besides the well-known poison ivy and oak, there are the spurges, whose milky sap can cause burns, blisters and even blindness. One widely cultivated spurge, Snow-on-the-mountain (*Euphorbia marginata*), is sometimes used instead of a hot iron to brand cattle. Not all milky saps are dangerous, but they're nothing to be played with either, unless you're an expert.

Foraging, of course, should not be dismissed out of hand, since a great many tasty and nutritious foods can be gathered not only in the woods but also in cities and suburbs (SMITHSONIAN, September 1976). But the outdoors should not be considered a super-



Black nightshade can stupefy anyone who bites a berry. Potato, eggplant, tomato are relatives.

market where everything carries an implicit government inspection sticker. The backyard isn't safe, either, a fact that is not fully appreciated by indulgent or negligent parents.

Aside from medicines of all types, plants are more often ingested by children under the age of five than any other single substance. Since 1972, the number of children eating poisonous plants has increased 20 percent; indeed, household and garden flora are more likely to be seized upon by children than aspirin. In poisonings treated medically, plants rank third behind medicines and cleaning agents among children in this age group.

Four of the most popular houseplants—dieffenbachia, philodendron, caladium and elephant's ear—are all members of the Arum family, and all contain calcium oxalate crystals and chemicals which cause irritation of the mucous membranes. Dieffenbachia (opposite) got its nicknames, mother-in-law plant or dumb cane, because, like other Arums, it can cause swelling of the mouth, tongue and throat, accompanied by loss of voice and inability to swallow. The

Foxglove, *Digitalis purpurea,* is not to be taken lightly, but is a boon to some cardiac patients.

victim can't get a word in edgewise. These plants don't deserve their humorous sobriquets, though, because the swelling can be severe enough to seal off breathing passages, causing death by suffocation.

Another dangerous indoor plant is the oleander (*Nerium oleander*), which also is used as an outdoor ornamental in the South. This species incorporates at least two toxins that affect the heart, plus saponins and gastrointestinal irritants, and can make a lethal feast of hot dogs and marshmallows skewered on its branches. The nectar of the oleander's pink and white flowers poisons honey, as does the Carolina yellow jasmine (*Gelsemium sempervirens*), the much-admired state flower of South Carolina.

Among the unwanted plants, one of the chief offenders is jimsonweed, or thorn apple (p. 52), which has white or lavender flowers and a colorful history. The toxic and hallucinogenic qualities of this weed (*Datura stramonium*) have been known since antiquity, and were studied 1,000 years ago by the Arab physician Avicenna. Its present name can be traced to 1676, when the British sent troops to Jamestown, Virginia, to quell Bacon's Rebellion. The soldiers, bored and looking for a change of diet, probably, happened upon a patch of *Datura* and cooked the leaves for greens, with massively intoxicating effects. As news of the incident spread, the plant began to be called Jamestown weed, shortened over the years to jimsonweed. The British troops were not the first to experiment with jimson. Marc Antony's army tried it when retreating from Parthia in A.D. 38, and history records the result as widespread stupor, insanity and death. The Chibcha Indians of South America used it to sedate their human sacrifices.

Another weed, nightshade, has an evil reputation but the real offender in the family is black nightshade (*Solanum nigrum,* p. 53), whose toxin, solanine, can cause severe gastrointestinal irritation and stupefaction. The generic term also refers to a great number of nonpoisonous plants. The potato, eggplant and tomato are all nightshades. They're all harmless as long as you stay away from the green parts. Rhubarb (*Rheum rhaponticum*) is another edible garden plant with poisonous leaf blades. The seeds of apples and the pits of peaches and apricots all contain cyanide, so children should be told not to confuse them with nuts, and they should be removed at the start of the home canning process.

There are more than 700 poisonous plants in the Americas, from toxic lichen on the Alaskan tundra to rare, poisonous blooms in the South American jungle. Many have proven uses. Reserpine from snakeroot (*Rauwolfia serpentina*), for example, is used to control high blood pressure. Digitalis, from foxglove (*Digitalis purpurea* p. 53), has long saved the lives of persons suffering from heart disease. The muscle-relaxing capabilities of curare, an arrow poison used by our prehistoric ancestors, is an adjunct to modern surgery and anesthesia, just as the selective toxicity of some of the molds has made antibiotics a medical byword.

Among the tantalizing new prospects is akee (*Blighia sapida*), a commonly eaten fruit of Jamaica. The akee is poisonous if it isn't ripe, because it lowers blood sugar, a finding which could turn out to be a benison for diabetics.

The most fascinating experimentation with toxins, however, is being done with jequirity beans (*Abrus precatorius,* p. 48), a tropical vine found in uncultivated areas of the South, and the castor oil plant (*Ricinus communis*). The colorful red and black seeds of Abrus have been used to make jewelry, toys and rosaries, although one or two seeds may contain a fatal amount of the abrin. The castor bean is a valuable commercial and decorative plant, but the beans contain toxic ricin; one to three, if chewed, can be fatal to a child. But both abrin and ricin suppress and destroy tumor growth in mice.

There are more than 300,000 plant species in the world, toxic and edible; each is a complex, living chemical factory and many have evolved pharmacologically active substances over the eons. A new breed of explorer is tramping through the alleys, vacant lots, wetlands, forests and mountainsides, trying to identify them, hoping to find cures or anodynes for the great scourges of Mankind. There is every reason to believe this new attention to the medical potential of the natural world eventually will pay off handsomely.

This is another hemlock, *Conium maculatum*. Its paralytic powers dispatched Athenian malcontents.

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the regional context in which it is produced. Art-historical scholarship only recently has begun to work on the modern art of California, and exhibitions have presented one fragment or another, but nothing approaching the community of modern artists as a whole.

A major effort to correct that deficiency has resulted in "Painting and Sculpture in California: The Modern Era," an exhibition of some 270 works by 199 artists that is scheduled to open at Smithsonian's National Collection of Fine Arts on May 20. The exhibition was organized by Henry T. Hopkins, director of the San Francisco Museum of Modern Art, and Walter Hopps, curator of 20th-century painting and sculpture at the NCFA. Support for the exhibition and its catalog came from the Foremost-McKesson Foundation, Inc., the Crown Zellerbach Foundation, Mason Wells and Frank Hamilton, and the National Endowment for the Arts. A larger version of the show was seen in San Francisco last fall.

One of the premises of the show is that modern art in northern California has always built upon a sense of the beauty of the natural landscape, whereas comparable artists in southern California have managed to avoid direct reference to the natural landscape; if their art has a southern California look, it is the look of boxy suburban architecture, brightly colored plastic, billboards, customized cars, and spray-painted vans and motorcycles, rather than the look of pristine hills, grass and sky.

That generalization might well be challenged by many artists, in both halves of California, whose work runs counter to the accepted view of what they ought to be doing. Nevertheless, even the early modern painting of southern California, before the region was overwhelmed by suburbanization, seems to derive more from the studio than from the landscape. The outstanding figures of the Twenties were Stanton Macdonald-Wright (opposite), and Morgan Russell, who met in Paris before World War I and cofounded a movement they called Synchromism. Their principles, based on extensive research in color theory but softened in their own practice by the use of intuition, were taken up by a whole generation of American abstract painters. Despite the eminence of Macdonald-Wright and Russell, however, no single style dominated Los Angeles in the Twenties.

During the Thirties California painting reflected its time. Picasso was widely imitated. Artists of left and right took up expressionist realism, as pioneered elsewhere by Diego Rivera and David Alfaro Siqueiros on the one wing, and Thomas Hart Benton and Grant Wood on the other. The Surrealists' use of biomorphic abstraction was echoed by such artists as Lorser Feitelson (p. 59), who worked with curved abstract forms. And the Surrealists' use of naturalistic painting technique to depict psychological associations and dream images was taken up by Helen Lundeberg, (p. 60).

Most of the exhibited work done before 1945 is muted in tone, as if it were a sad thing to be an artist in California. After World War II, however, American art experienced an unprecedented upsurge of energy.

One of America's first color abstractionists, Stanton Macdonald-Wright paved way for much that followed. This is his *Dragon Forms*, 1926.

The author is a free-lance writer specializing in art journalism and is a guest curator at the San Francisco Museum of Modern Art.

This century's art in California

The new, optimistic spirit became manifest at the California School of Fine Arts (now the San Francisco Art Institute) between 1945 and 1950. Founded in 1874 as the California School of Design, it was the fourth-oldest art school in the United States, and traditionally had been a nice place for well-to-do kids to play at creativity. But after the war the G.I. Bill of Rights brought older, more serious students to American colleges, and for a time the CSFA benefited appreciably from that change.

The late Douglas MacAgy was appointed director of the school in 1945, and given carte blanche. He hired new teachers, mostly young and innovative. He also brought in a new, more ambitious attitude, most vigorously expounded by his star teacher, the Abstract Expressionist painter Clyfford Still.

It was precisely Still's attitudes that made the difference. As one student recalled, "From time to time Still would enter the classroom and begin to extemporize about the 'revolution' which was going on in painting, insinuating that the center of it was precisely in the room where we all were at the moment, and that we were engaged in some conspiratorial movement together, subverting the value of [earlier] Western art. The reactions to a few moments of that kind of pep talk would send everyone back to his easel with the renewed conviction that the making of abstract painting was almost a secret weapon, in the cause not only of beauty but of truth as well."

After MacAgy left, in 1950, his experiment fell apart. Some of his teachers and students made careers in New York. Most of those who remained have fallen into obscurity, either because they were less ambitious or because San Francisco was uninterested in supporting a modern art community.

As in New York, the triumph of Abstract Expressionism in San Francisco was followed by a return to figurative painting, of which David Park, Elmer Bischoff and Richard Diebenkorn were practitioners.

Modern figurative painting is an ambiguous enterprise. When abstract art arrived on the scene, it was clearly and uncomfortably modern; artists as well as laymen were disconcerted by it. There is some question as to whether a painting that looks like an advertising illustration or an enlarged snapshot really proposes to be modern with the same degree of intensity. Whatever formal games the artist may be playing, the use of familiar subject matter reduces discomfort for both artist and viewer. Painting of that kind has been done at a high level by Wayne Thiebaud, Mel Ramos, Robert Bechtle, Ralph Goings (p. 61) and others.

Richard Diebenkorn prefers to make no fundamental distinction between abstraction and figuration; he has done outstanding work of both kinds. He first came to prominence for such paintings as *Berkeley #1*, 1953 (opposite), in which hints of the Bay Area landscape, as it might be seen from above, emerge from what was basically Abstract Expressionist painting.

The time had come for a little humor

In 1955 Diebenkorn took up a kind of figurative painting with strong abstract elements. Whether he was painting a backyard swimming pool or the interior of a room, one was aware of the geometry inherent in those subjects. He moved to southern California in 1966, and since then he has done large-scale abstract paintings that seem to many observers to reflect the clean lines and pastel colors of suburban Los Angeles.

Abstract Expressionism was deadly serious stuff. By the late Fifties it was time to smile a bit, and New York came up with Pop Art. Humor has seldom been a dominant theme in New York art for very long, but in the relatively lightheaded atmosphere of northern California, many of the region's most eminent artists play for laughs.

One thinks of the ceramist Robert Arneson, whose pursuit of virtuoso craftsmanship led him eventually to the making of rude jokes. There is the painter Roy De Forest, who once said in a lecture that he hoped some day to adopt the simplifications of Mondrian; for now, his experiments in color organization come out as humorous horses and dogs. And there is William T. Wiley, a brilliant watercolorist and a playfully intellectual artist in many media, who drives his playfulness home with misspellings and heavy puns.

The postwar art of Los Angeles has been distinguished for the exuberance that its artists have expressed in a variety of forms. Peter Voulkos, a ceramist from Montana, began teaching in Los Angeles in 1954. Almost immediately he gathered about him a group

Richard Diebenkorn is known for both figurative and abstract work. Good example of latter is *Berkeley #4*, 1953.

Mr. and Mrs. Joseph M. Bransten, San Francis

San Francisco Museum of Modern Art

A towering figure in modern American art, Clyfford Still painted this untitled work, 58x25½ inches, in 1941.

Mr. and Mrs. Lorser Feitelson, Los Angeles

Lorser Feitelson's *Magical Forms*, a biomorphic abstraction (based on life forms), was done in 1948.

Art Museum, University of California, Berkeley

Of glazed earthenware, this rather daunting typewriter is the work of Robert Arneson, 1965.

Mr. and Mrs. Lorser Feitelson, Los Angeles

Impeccable technique was used by Helen Lundeberg in *Double Portrait of the Artist in Time,* 1935.

of student-colleagues who have since become independently successful, notably John Mason, Kenneth Price and Billy Al Bengston.

Voulkos and his circle broke away from classic pottery and pioneered in the use of clay for an informal combination of painting and sculpture; as might be expected at that time, the style was called Abstract Expressionist ceramics. Except for Mason, the artists have gone in new directions. Bengston has made a career as a painter; Voulkos himself moved to Berkeley in 1959, and since then has begun doing monumental sculpture in bronze.

Consistent with the economic expansion of southern California in the Fifties and Sixties was the so-called "L.A. look" in art. The painting was clean and uncluttered, devoid of expressionist turmoil and anguish; the sculpture often was made of clear plastic in pretty colors, or glass. Whatever intellectual or spiritual ideas underlay the work, it is also true that these objects fit neatly into a social environment where new wealth was based on new technology; a gleaming row of windows in a new industrial park could be echoed by an equally gleaming row of art objects.

In the more recent development of Los Angeles glass-and-plastic art, as practiced by Robert Irwin and his followers, the object tends to disappear. One no longer sees a highly designed object in a nondescript room. Instead, there is a calculated room where the viewer's experience of the work of art resembles an experiment in perception. Like a meditation teacher, Irwin might explain that his way approaches fullness through emptiness. These works reiterate one of the central questions of modern esthetics: "What can art do without, and still be art?" To which Robert Irwin's answer is, "Almost everything."

A flowering of modern art

The most important institutional event in the flowering of modern art in southern California was the opening of the Ferus Gallery in 1957. This enterprise joined the talents of a gifted appreciator and educator, Walter Hopps, with those of a distinguished assemblage sculptor, Ed Kienholz, and energetic art-world business people, Irving Blum and Sadye Moss. The Ferus exhibited art by young Californians, and also by modern masters less well known in Los Angeles than Picasso and Chagall: Kurt Schwitters, Joseph Cornell, Giorgio Morandi, Joseph Albers. In addition to showing art, Hopps and his circle played a large part in educating the audience for modern art that now exists in Los Angeles.

The need for education was enormous. Henry Hopkins recalls that during his Los Angeles days he and his coconspirators would literally go into the home of a

prosperous Angeleno, and there give a slide show that embodied a crash course in art history. The existing museums and galleries, try as they might, had not been able to do the job.

Energetic pushing by a few curators, critics and dealers created an art boom in Los Angeles during the Fifties and Sixties; the boom subsided with the onset of economic recession at the end of the decade. More recently, the San Francisco art market has grown. On the whole, however, neither Los Angeles nor San Francisco has had anything like the mass of sophisticated money-chasing art of Paris and New York.

California has lacked the great public collections, the cultural journalists, the educated public—in short, the art support system—of a world capital. But it must be remembered that Paris and New York are the economic and intellectual capitals of their respective countries, and that each in turn has assumed cultural stewardship of the entire Western World; no such development is likely to occur in California in the foreseeable future.

The best that can be hoped for is that California will invent a new kind of art center; the dazzling examples of Paris and New York have paralyzed thought and action elsewhere, and it would be most useful if California managed to solve that problem for the whole world.

If this exhibition teaches us anything, it is that there is no California style. What characterizes art life in California is not any formal tendency, but a naive faith in the possibility of salvation through art. That faith is not so easy to maintain in more sophisticated places. Even if the social order seems to be running down, California art, in all its energy and diversity, seems to be still at the beginning. That sense of new beginnings is its strength.

Superrealists heighten familiar everyday scenes, as in Ralph Goings' *Paul's Corner*, 1970.

Max Palevsky, Los Angeles

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By Sol Stember

En avant with our French allies to Yorktown victory

When Rochambeau's army marched to share the Revolution's end, they acquired frogs, friends and intimate knowledge of the land

On June 10 and 11, 1781, approximately 4,000 soldiers of France led by the Comte de Rochambeau started out from Newport, Rhode Island, to join American troops on the Hudson River, 180 miles away, for combined operations against the British on Manhattan.

Owing to the exigencies of war, their route was extended far beyond New York City. Most of them arrived in Williamsburg, Virginia, 108 days and some 500 miles later, having walked most of the way. En route, they camped at 39 sites in eight states. They made their last camp in Williamsburg and then constructed and moved into siege lines around Yorktown, where the British army of Lord Cornwallis soon was forced to surrender.

In an age when armies customarily used foot power to get around, the French expedition was tame and uneventful. Nevertheless it was a remarkable feat, not only for what it accomplished but for what it managed to avoid. It led to the ultimate victory that gained American independence. It did not leave behind a trail of broken heads, looted homes, plundered farms and raped women; and it presented posterity with a relic of the Revolution.

Heading for the Hudson and points south, French soldiers swung south in two columns, producing excellent maps of each day's march and campsite. Those of Captain Berthier guided the author.

With the French were officers whose job it was to map the march route beforehand, if possible, or as the army proceeded. Most notable among them was 27-year-old Captain Louis-Alexandre Berthier, eldest son of France's chief military topographical engineer. Tutored by his father, Louis-Alexandre had joined Rochambeau as a cartographer on the quartermaster general's staff. When he wasn't out looking for horse fodder, he was recording details of the march. As he rode along, he made notations of every turn, of every up and down grade, every stream crossed, every church (he called them meetinghouses), tavern and farmhouse, every field and orchard, every wood and hill in sight, every intersecting or branching road, noting where it led to and came from. At the end of each day's march, he drew a sketch that eventually became a completed map of that day's section of the march and for a nightcap knocked off a map of the campsite.

The result was a collection of maps that survived among Berthier's papers in his ancestral home (he later became Napoleon's chief of staff, so his papers must have been voluminous). Addended by his written observations, these maps provide us 196 years later with an authentic slice of the American Colonial landscape from Providence, Rhode Island, to Wilmington, Delaware. Many of the maps and the journals of three French officers who participated in the march, including Berthier's, were gathered together, translated and edited by Howard C. Rice jr. and Anne S.K. Brown and published jointly by the Princeton and Brown University presses in two volumes. I took them with me when I set out to find and identify some of the French campsites.

A search for old landmarks, if any

I was accompanied by my wife Rosaline, my inveterate navigator, relief driver, research assistant and fellow traveler who keeps me headed in the right direction when I vehemently insist we should go the other way. As we went along, I made notes of what I saw, like a sort of latter-day Berthier, in an attempt to ascertain which landmarks described by those French mapmakers of almost two centuries ago have survived.

We began with a brief visit to Newport to see again some of the handsome 18th-century buildings that grace its streets, particularly those few still extant in which French officers were billeted. Then we drove for about an hour at moderate speed to Providence. It took the French army two days to cover the same distance, about 25 miles, but in small boats up Narragansett Bay and the Providence River.

For eight days in Providence, the French trained and prepared for the march. During that time the officers were billeted in private homes as guests of the

Illustrations by Arthur Shilstone

city. Rochambeau was in the home of Deputy Governor Bowen and more than 50 others were placed in homes and taverns. Only two of these buildings have survived: the Joseph Brown House at 50 South Main Street, now private offices, and the Benjamin Cushing House at 38½ North Court Street (then on North Main Street), which sheltered the aides of the Chevalier de Chastellux.

Though there naturally had been a good deal of traffic between the French camps in Newport and Providence and the townsfolk were accustomed to the sight of French uniforms on their streets, some of the aristocratic habits of these foreign nobles struck republican-minded Americans as peculiar.

American townsfolk along the way were amused at couriers who jogged beside mounted French officers.

Eliza Lyman reported in her memoirs of life in Newport that two of the French officers were attended by running footmen whenever they rode "and this was no sinecure as they always went on a galop. . . . The young men selected for this service were tall and slender, wore thin kid slippers and held a staff in their hands which occasionally assisted them in leaping forward. As soon as they returned from one of these expeditions, they took something hot to drink and went to bed. . . ."

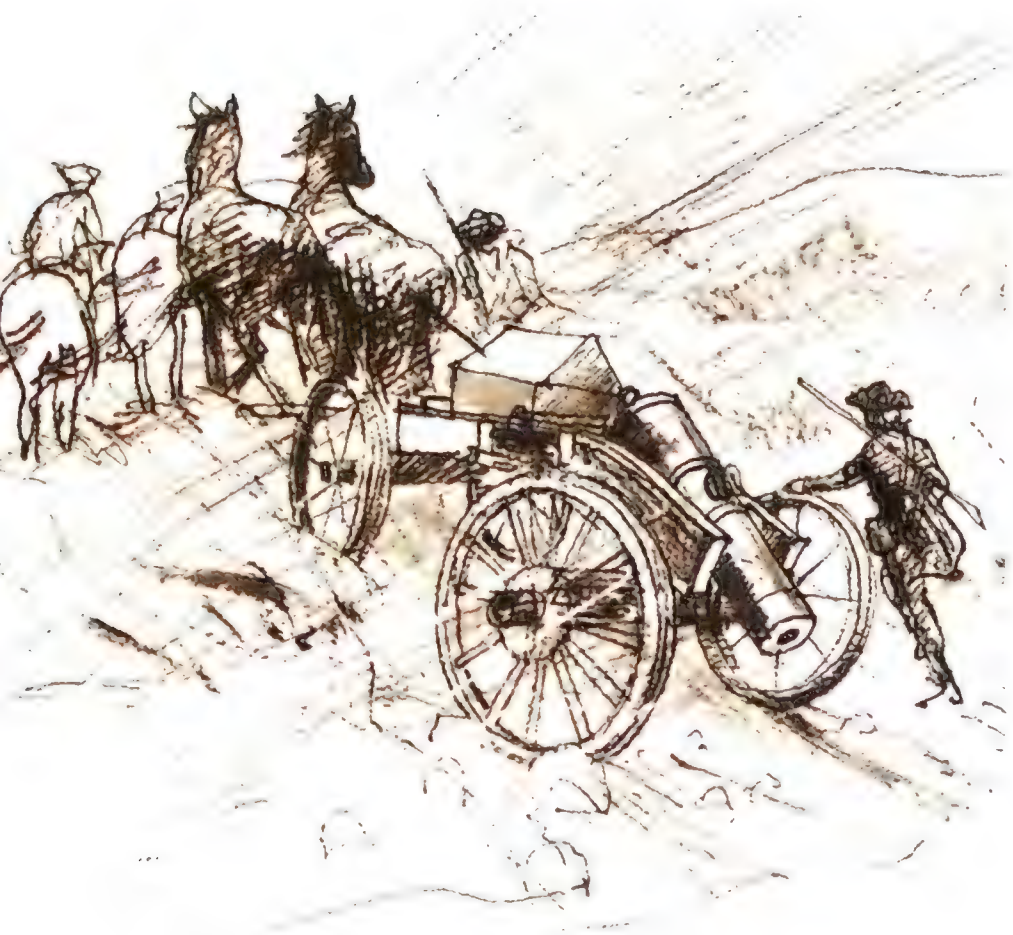
From Rhode Island to New York, the army marched in four divisions with two columns each, following separate but parallel routes. The column on the left was the Legion of Foreign Volunteers, a mixed bag of Poles, Irish and Germans, commanded by the dashing Count Armand-Louis Conaut, Duc de Lauzun. It formed a shield against possible British attacks from across Long Island Sound as the army moved through Connecticut. Each of the divisions in the right column was composed of an infantry regiment, one-quarter of the artillery, part of the baggage train and a field hospital. These divisions marched one behind the other a day apart so that each campsite was occupied on at least four successive nights. The four regiments were the Bourbonnais, the Saintonge and the Soissonnais, named for the provinces in which they had been recruited; and the Royal Deux-Ponts, commanded by Colonel Christian de Deux-Ponts, and made up of Germans from Deux-Ponts (Zweibrücken), a duchy in the Rhine Valley. The men of the Deux-Ponts were French nationals heart and soul. A number brought their wives and children on the march.

Bakers produced bread en route

Each division was preceded by a number of "pioneers," half of whom were armed with axes. At certain predetermined sites—East Hartford was one, Suffern, New York, was another—bake ovens were built in which the army's bakers turned out several days' supply of bread. Rochambeau's personal baggage and a wagon carrying the army's "trésor" (expense money) led the baggage train that accompanied the Bourbonnais. It was commanded by Rochambeau himself.

The troops were roused each day at 2 A.M. and were on the road two hours later. The day's march usually ended any time between 10 A.M. and noon, by which time the column had reached the next campsite—except for the artillery and the baggage wagons. Bad roads exacted a fearful toll of wagons, and artillerists and wagoners often rolled into camp just in time to join the infantry on the next day's march.

The men slogged along at a steady pace, averaging about 15 miles a day, occasionally having to ford unbridged streams in the absence of ferries. That



Rochambeau's artillery, divided into four parties, struggled along behind the infantry.

summer was unusually hot and humid and the heat undoubtedly intensified the farther south they marched. There were no skirmishes or battles along the way but there was torrential rain, turning roads to sloughs, and there were hills to climb. Morale remained high. People were generally friendly and food was usually in good supply. Every fifth soldier carried a bottle of vinegar which he and four of his comrades mixed with their drinking water to prevent malaria. Each man had a red flannel belt around his waist to guard against cholera.

Since each division halted its march relatively early in the day, once camp duties had been attended to the men had time to meet the local inhabitants, who frequently gathered in the camps to stare at the foreign soldiers and to sell local produce. In a period when campaigning armies were not known for good manners, the French army achieved a well-deserved reputation for its discipline and good behavior.

This was all the more remarkable, because the French had discovered soon after their arrival in America that young Americans, and particularly young women, were treated with a permissiveness that would have raised eyebrows in France. Young men and women kissed each other a good deal, engaged couples spent a great deal of time together unchaperoned and, in Connecticut, they were allowed to "bundle." These liberties were hospitably extended to the French.

Their admirable restraint was due in no small part to Rochambeau, who boasted in his memoirs that not one duel occurred between American and French officers during the two-and-a-half years his army was in America. A member of an ancient family, Rochambeau had already served king and country for 37 years when in 1780 he was summoned to the command of the French expeditionary force to America. He proved practical and resourceful, no martinet yet insistent on firm discipline.

So the French moved from camp to camp through Connecticut. Now a private residence (it was their first stopping place), Waterman's Tavern is a two-story white frame house with a federal eagle poised over the door. Behind the house are two rock-lined wells said to have been dug by the French, who pitched their tents on the opposite side of the road at the foot of a sloping field.

Camp No. 6, at East Hartford, is today a commercial park called Founder's Plaza, just off Routes 84 and 91. Camp No. 8 in the Marion section of Southington was near Barnes Tavern, now a well-preserved private home. Southington historians informed us that the residents of the town were intrigued by French "Continental manners." There was a dinner and ball that lasted all night. Soon, however, the army received orders from Rochambeau to march by brigades, resulting in tighter discipline and less fraternization.

Frogs give legs for liberty

Camp No. 11 in Ridgebury is identified by the Ridgebury Congregational Church, built in 1760 and noted on Berthier's map, at the intersection of Ridgebury Road and George Washington Highway. The army placed its tents on what is now an open field a short distance from the intersection. Berthier and an advance detachment camped across the road from the Hunt House at the intersection of Old State Coach and Ridgebury Roads. A spring still flowing behind the house was almost emptied by the thirsty French. This led to the discovery of a large colony of frogs, which at once were prevailed upon to donate their legs to French appetites and the cause of liberty.

At Ridgebury, Rochambeau was informed that General Washington had begun operations against the English, which caused the French commander to force-march his men to North Castle, now Mount Kisco, in present-day Westchester County, New York. The French spent six weeks in the area, playing games with the British in and around lower Westchester

A free-lance television producer-writer, Mr. Stember has written travel articles for the New York Times *and the* Bicentennial Guide to the American Revolution.

while their commanders probed New York defenses.

During one reconnaissance in force involving 5,000 French and American troops, Rochambeau and Washington lay down to rest in the shade of a hedge on a small island in Long Island Sound, fell asleep because of the heat and woke to find that the tide had risen, cutting them off from the mainland. They had to be rescued in a small boat and brought to safety with their horses swimming along behind them.

On August 14, Rochambeau received word that Admiral de Grasse, with a strong French fleet and an army, was sailing from the West Indies for Chesapeake Bay. Cornwallis by then had retired to Yorktown with his back to the sea and was being kept under observation by the Marquis de Lafayette, commanding a small American force. Recognizing the opportunity, Washington ordered the combined armies to march for Virginia. They crossed the Hudson River via Kings Ferry from Verplanck's Point to Stony Point and headed southwest through present-day Rockland County for New Jersey. They marched over existing roads to Suffern and camped on the banks of the Mahwah River, then proceeded south through New Jersey along what is now Route 202 (the Ramapo Valley Road). They passed the Van Allen House, still standing in Oakland, on their way to campsites in Pompton Plains (marked by the First Reformed Church), in Whippany, Liberty Corner, Millstone, Princeton and Trenton.

Troops take advantage of a break. Arising at 2 A.M., they camped before noon after about 15 miles.

Frog colony in Ridgebury, Connecticut, was decimated by delighted Frenchmen, according to old journal.

They crossed the Delaware by ford and ferry and headed for Philadelphia. They camped at the Red Lion Tavern, now a forgotten site at the Philadelphia city line, then near the Schuylkill River in the vicinity of Rittenhouse Square. The city's populace greeted them with enthusiasm; they were reviewed by Congress and wined and dined. Rochambeau was induced to part with "20,000 hard dollars" from out of his "trésor" to pay Washington's men some of the money they were owed. In the midst of a banquet, French Ambassador Luzerne received word in most dramatic fashion that De Grasse had reached Virginia and had landed reinforcements for Lafayette. The time had come to spring the trap.

The march route now led through Wilmington, Delaware, then Elkton (Head of Elk, in reference to the Elk River). Expected naval transports at Head of Elk could take on only part of the army and most of the men pushed on toward Baltimore where additional ships were promised. Rochambeau and Washington rode ahead to join Lafayette after a stopover at Mount Vernon.

With the help of a map prepared for us by Cecil County historians, we followed the French army route along the old Baltimore Post Road through Maryland to Havre de Grace and White Marsh.

In Baltimore we discovered that Camp No. 34, once in open country overlooking the city and its port, had been swallowed by urbanization. Here once again a naval transport failed to materialize, and the army continued its march. Before they moved on, however, the French discovered kinsmen. These were French Canadians who had been ejected from their homes in

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Acadia decades before by the British. They had resettled in Maryland rather than in Louisiana.

We found Camp No. 35 at Spurier's Tavern, on the banks of the Patapsco River in Patapsco State Park, by referring to Berthier's map of the return march camp and with the help of a park ranger. We also found where the French forded the treacherous stream at an old industrial site between a 19th-century iron bridge and the Interstate 95 overpass. Camp No. 36, made by the French on September 17, turned up ten miles outside Annapolis.

In Annapolis, the French infantry finally made it onto ships that took them to a safe landing on the James River, to the relief of their bunions, I am sure.

Camp No. 38, at Archer's Hope, is alongside the Colonial Parkway between Williamsburg and Jamestown, where the French who had embarked at Annapolis came ashore in Virginia.

In and around Williamsburg, Camp No. 39 consists of a number of sites indicated on the Berthier map of the area. American troops were camped in what is now an open field along U.S. 60 opposite the Patrick Henry Inn. Some French troops were camped behind the inn where the railroad line runs alongside Routes 5 and 31. Still others were on the high, wooded ground behind the restored capitol building in Colonial Williamsburg. Lafayette's American troops were ensconced in the general area behind the William and Mary College Stadium, and Saint-Simon's West Indians bedded down in a wooded area off Richmond Road and Nelson Avenue. They were all to be congratulated, these French, not only for having survived all that walking but for finding places to sleep in Williamsburg without reservations.

From Williamsburg the French marched the few remaining miles into the siege lines around Yorktown. During the siege, which lasted from the evening of September 28 until 2 P.M. on October 20, when the British army marched out to surrender, French losses were 60 dead and 197 wounded. The names of their dead are inscribed on the victory monument at Yorktown. The French then went into winter quarters in Williamsburg and remained there until the end of June 1782. On July 1 they left for Boston and embarkation home. But for them, that was just another march—hardly worth the mention.

French divisions bequeathed a legacy of good feeling, paying for supplies and avoiding romantic disasters.

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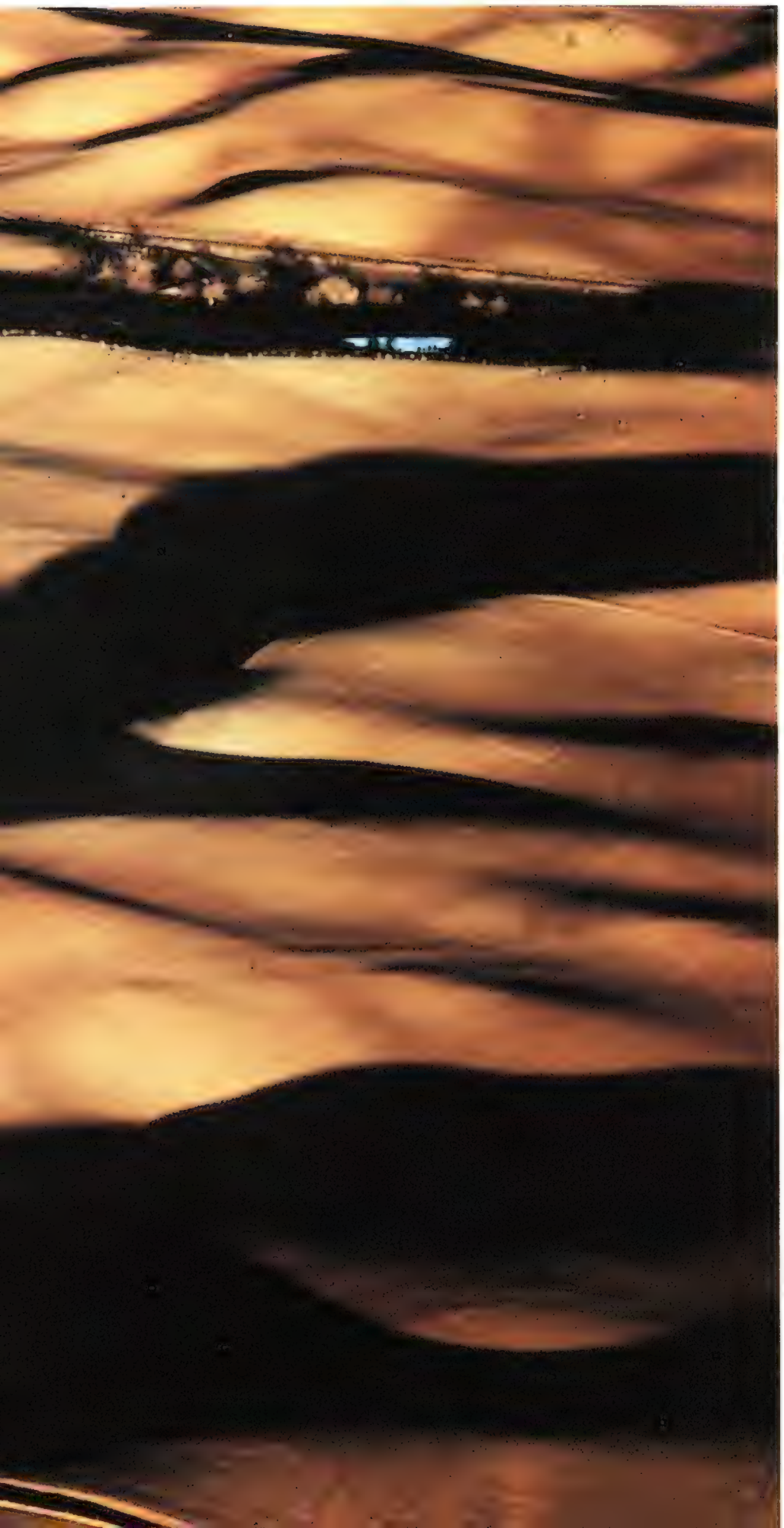
By Edwards Park

The eye of Bill Garnett looks down on the commonplace and sees art

Part Picasso and part Red Baron, this flying professor with his Cessna and his camera finds beauty and meaning in desert and dump



At the end of the apron, past a scattering of parked airplanes, stood a long, corrugated steel shed that reflected the lowering sun. It was divided into individual hangars, each wide enough to accept the wings of a small plane. Bill Garnett unlocked the telescoping doors of Number Five and rolled them back.

The sun danced on the polished aluminum skin of a little Cessna 170B, 21 years old, but bright and clean as a new toy. She sparkled from her round propeller spinner to her sweetly curved tail section. No modern tricycle plane this, perched like a tea caddy on a triangle of wheels. This was an old-fashioned "tail-dragger," though you wince to use that pilot's phrase on such a dainty and yearning creature.

"This is my little bird," Bill said, with the shyness of a man introducing his mistress.

We rolled her out of the shed, checked her over and climbed aboard. Bill ran her up, called Napa County tower for clearance, and we were in the air in a scant hundred yards.

Below, the first lights were beginning to come on along the streets of Napa, California. San Francisco Bay lay south of us, while to the north the famous wine valley tapered away between hills touched by sunset. It was too dark for pictures, but Bill Garnett wanted to show me two things: his little silver sweetheart and his view of the Earth's surface. Together, these two have shaped his life.

William A. Garnett is one of the world's most respected aerial photographers, whose eye selects from the panorama below certain natural formations, man-made contours, grainfields, still lakes and mountain shadows that are the special subjects for his camera. For nearly 30 years the eye of Bill Garnett has hunted down and captured views of the land that range from significant social assessments to glorious abstractions.

In the twilight, he lifted the Cessna to 2,500 feet, where the sun gilded her flanks. He throttled back and spoke: "First you have to understand this plane. Without her I can't make pictures, so the way she behaves is important. Watch the way she stalls."

Up came the nose, and down dropped the airspeed until all sound of movement ceased. We hung there, barely moving, quiet, yet still magically level and stable, suspended atop a tall column of warm California air. And then Bill rocked the wheel gently, and the plane rocked—obeying the controls perfectly instead of dropping into a rebellious spin.

"Open your window and put your hand out."

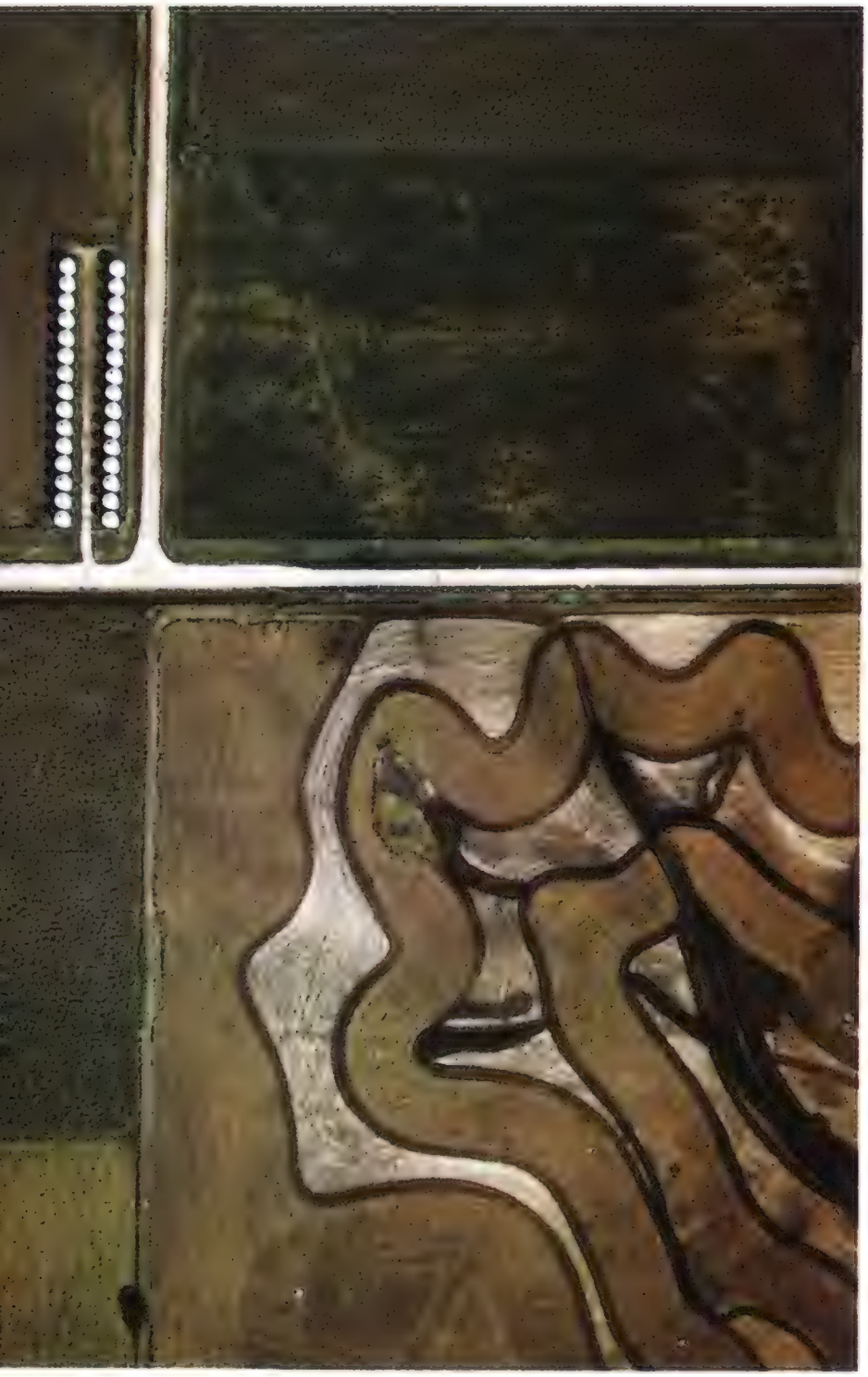
I did. Instead of hurling my hand back with vicious

Setting sun outlines California's rolling Dunnigan Hills, highlighting the farm buildings and sheep.

force, the air was a mere breeze, a summer zephyr on a hilltop. The climb indicator showed a slight descent; the altimeter was gradually unwinding as we sank slowly down in the sky. Bill lowered the flaps and with all her speed gone, his little bird settled gently, wings still level, nose still high. He pushed the nose down just below the horizon, added throttle, and the stall was instantly washed out and flight restored.

"I need that kind of low-speed control to get my pictures," said Bill. "You'll see."

He brought us down toward the darkening earth with a series of graceful turns, letting the plane fall off on one wing, then rolling her onto the other. At 1,000 feet, he banked steeply over a man-made salt pool, a drab square cut in the drab ground, filled with



Midwest farmland with roads, aligned silos and contour plowing pattern produced this composition.

Mineral brine in the blistering desert land of Owens Lake, California, offers another abstraction.

discolored water and lined with dirty salt. It seemed about as enticing as a puddle in the city dump.

"That's the sort of thing I see," he told me. "I've shot that salt pool lots of times."

I glanced over at him dubiously.

"Look at it," he said. "Really *look*."

And then I saw that the stagnant water, still and gummy, reflected the evening sky and magically turned maroon before my eyes. The salt banks gleamed in white or pale blue contrast. As we orbited above, new colors appeared and new shapes formed.

But the darkness was spreading over the land. Bill straightened and slid into the Napa airport traffic pattern. Engine idling, propellers ticking over, the plane sank reluctantly toward the runway, flared, reached for the tarmac with its tail and found it with a little squeak of rubber. We rolled maybe a hundred feet and turned off to Hangar Five. Tomorrow we would fly a photographic mission, cameras armed, targets in mind.

Fog provides a chance to talk

But tomorrow dawned white with fog. Bill and I spent the morning exploring the famous Napa wineries—I tasting, Bill not, since he would be flying later. I got him to talk about himself.

Bill Garnett looks a bit like a professor at Berkeley—which he is. He teaches aspects of photography there, and he is spectacled and slightly stooped. As he talked, he drove his Fiat with an absentmindedness that left me white-knuckled. He remembered with enthusiasm a view he had seen, with anger an environmental rip-off that the authorities plan. He gestured and turned toward me, and the traffic squealed out of his way.

Garnett's career was born on a miserably snowy December day in 1945 when he was a private in the U.S. Army Signal Corps, trying to hitch a ride on a plane from Newark, New Jersey, so he could make it home for Christmas in California. To get aboard a transport, he had to pass himself off as aircrew (with the connivance of pilot and copilot). He ended up in the navigator's seat, nose pressed to the window as the wintry landscape unrolled beneath him. By the time he reached the West Coast he had fallen in love with flight, and also with the land. He wanted nothing so much as to display for everyone the beauty of the land as flyers see it. It's not a new discovery—every pilot knows what the land looks like. But Bill wanted to record the aspects that tickle even a pilot's jaded fancy, and which to a groundling are unutterably beautiful and as alien as the face of Saturn.

So he learned to fly and to photograph. Years of publication in magazines and books prove his success. Yet I still didn't know how he did it.

Flying with one elbow, Garnett shoots through open window. Sun-shielding hat bends out of his way.

Some years ago I was taught some basic photography by an old magazine pro. The results were more or less humiliating for me, but I do remember how he hammered home visual concentration.

"When you're driving," he would say, "and you come across a view and hold up rush-hour traffic while you stop your car and stare at it, and you don't even hear the horns being blown at you—*then* you're beginning to think like a photographer."

Even more years ago I was taught to fly by a young man with gentle instincts who was forced into a mild tyranny by my ineptitude. He could talk to me through a device known as a gosport. I couldn't talk back. I could talk only to myself. Like this:

"I want those RPMs at 2250, not 2265." *Oh-oh.* "Were you thinking of dive-bombing that silo? Get your nose back on the horizon." *Boy, that was dumb.* "I said the course was *90* degrees!" *Oh gosh.* "Keep your wings level." *Damn!* And so on.

My own modest experiences, then, made me wonder how anyone could put two such demanding disciplines into harness and make them team up productively. I was about to find out.

The last wisps of fog blew off at noon and we rose above them, climbing over the bare ridges east of Napa and soaring above the Great Valley of California. Here the air had a reddish tinge. The winds of summer were flicking soil from the tilled land and holding it in the thermal currents that rose from ground temperatures of more than 100 degrees Fahrenheit.

We cruised northward above a gleaming highway, watching cars and double-trailer trucks plunging through the furnace below. Eat your hearts out, I thought, cool in the little cabin, 2,000 feet above.

Beside the highway, broad fields changed color from

yellow to water-streaked green. "Rice," Bill said. "They're spraying it. Sometimes makes a picture."

Almost immediately I spotted a yellow plane trailing a ribbon of vapor, skimming just over a rice field. It reached the boundary, pulled up sharply, dropped its nose to one side, then settled back above the rice to lay its plume on a fresh strip. Bill matched our speed with the duster's, wheeling above him as he did his stall turns, making a photograph occasionally from his open window. But the light was bad and the time fleeting. At Willows we dropped in and landed, Bill making an effort to "grease it on" because, as he pointed out, "they know me here."

Sure enough. Willows is in the heart of rice country, and in no time we were in a restaurant, packed into a huge booth with a half-dozen duster pilots. They were noisy and amusing, almost all former service airmen, imbued with the macho outlook and absorption in the business of flying that I recalled from a certain fighter squadron in a certain distant war. Had Bill and I driven into Willows, they would have said scarcely a word to us except to ask, politely, for the Tabasco. But we had flown in and so were included in the roar of conversation, the retelling of extraordinary feats, illustrated by hand gestures, the easy profanity and unwitting arrogance.

Instantly spotting me as a has-been, the crop dusters treated me with kindly tolerance and called me "sir." Bill was another matter. There he was, quietly professorial, cordial and dignified and mannerly, talking with an old test pilot whom he knew. And every time the professor began a sentence with "I remember . . . ," uttered no matter how softly, the crop dusters would hush and listen. To these young tigers, I realized, Garnett is an old sabertooth.

At ten to six next morning, we rolled the Cessna out and took off in cool, glassy air, climbing well up and

aiming for the distant white cone of Mount Shasta, far to the north. Red Bluff and Redding slid by below, then the tiny Sacramento River winding between high ridges. And Shasta came near, rising more than 14,000 feet to greet us, an unassailable queen wearing an ermine stole.

Buffeting wind usually preserves a high peak's privacy from snoopy little Cessnas and Pipers. But Shasta's guard was down that morning. Even skirting her elegant shoulders we found the air still and smooth, and we all but flicked a wing tip on her snow in our intimacy with her. I snapped away deliriously with Bill's number three camera, but Bill held his fire, for he'd seen Shasta many times before and wanted to save film for some lava beds to the northeast.

So we left the queen and slid away down the sky toward the gleam of Tule Lake. Here the earth was barren with black forms, straight from some dark moon, and the still early light gave them substance. Bill got to work.

He trimmed the plane for a slow descent, left it to fly itself (I was itching to take it, but the idea was to see how Bill operates by himself) and got his cameras ready. At the right altitude he throttled back, re-trimmed, opened his window and with one elbow laid the plane on her side. Thus in a steep bank, circling his target, he seemed to lose himself in his viewfinder, grabbing every ground effect that swam into his sight as the light and the angle changed.

The plane, of course, sagged downward as planes do in a near-vertical bank. Holding the controls with elbow pressure and playing the rudder pedals with his feet, Bill kept her at it, letting the altimeter gradually unwind. The air grew hot and bumpy. The ground came closer. The lava looked harder. I began to get sweaty in the palms and tight in the gut.

At last Bill dragged himself away from the viewfinder and, noting my avocado complexion, a color achieved by mixing turbulence and terror, kindly let me fly the plane back upstairs while he changed film. And so the morning went, Bill orbiting his targets at slow speed in tight turns, letting the plane sink while he snapped newly revealed angles.

We soared up to Klamath Falls, Oregon, and goofed off while the sun was high and the land contours lost to view. In late afternoon we flew south again, dodging mighty thunderstorms that were laying siege to Shasta, winkling through a tracery of hail and popping out to find the valley just as hot and dry as ever.

This time we edged closer to the hills that bounded

Boomed logs in a Washington state millpond
look like a design for tapa cloth in the South Seas.

it on the west. They form a rain shadow, keeping the western edge of the valley arid enough for sand dune formations. And in late afternoon, each dune threw its own shadow so that the ground waved with black and tan convolutions, symmetrical and pleasing.

Even I saw that picture. Bill was upon it like a beagle on a rabbit and we banked, slowed, circled and sagged, while I simply shrugged and thought, What the hell—today has been great even if it is my last.

We flew back to Napa. Next day we headed south in the valley, then edged into the Sierras for some spellbinding scenery. I began to sense what Bill was after, sometimes spotting targets before he did. He likes repeated patterns, even plow furrows in some lights. He likes formations that tell a story—the wrinkled, strangely plastic-looking tailings left by gold dredgers years ago, the green circles perfectly drawn by rotating irrigation nozzles. He likes still water with the contours of the bottom easily read. He likes the erosion effects of dry gulches.

He will shoot in the bumpiest weather, his little bird bucking rebelliously, her control wheel smacking him in the elbow while he leans out his window and tries to find a moment when the ground stops pitching and twisting in his viewfinder long enough for the snap of a shutter. By that time, any passenger is usually begging for mercy,and Bill may have lost his hat.

Then he will straighten, lay aside the camera, add throttle and climb to the smooth air. "All right," he will say soothingly to his plane. "All right, baby." And when he's not taking pictures, when he's on a jaunt over land that he's already recorded in every possible mood, he'll play with his silver bird, taking her far up to skim the crest of Mount Whitney, then letting her drop with abandon from that gasping height to the superheated air of Owens Lake, where mineral brine needs to be checked upon every once in a while to see what new colors it may have (p. 76).

On my last day with Bill, he flew me down to Los Angeles to catch my plane East. We kept over the mountains until they flattened into the Mojave Desert, and then we eased through the pass toward San Bernardino and turned southwest to a small airport.

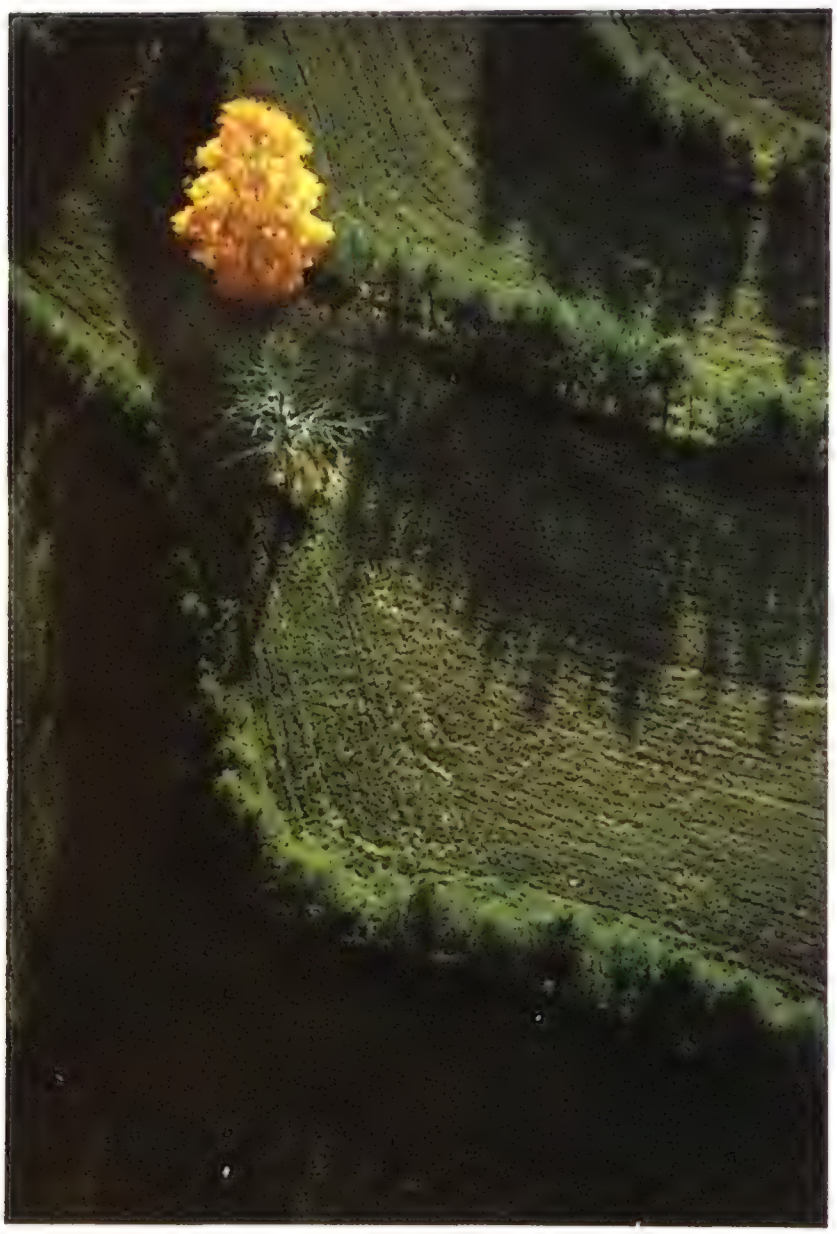
Never had I seen Los Angeles to worse advantage. From the clear air of the desert we were venturing into a gray-brown soup that boiled up the 5,000-foot mountain passes and tumbled through them in noxious waves. It was a repelling sight.

Bill coped with it, gritting his teeth and, like me, rubbing his sore eyes. We felt our way cautiously into the murk, I trying to spot other planes, he trying to find the airstrip he wanted and coming as close to swearing as I ever heard him.

"I was raised here as a boy," he said. "And it was bright and clear and filled with the scent of orange trees. This is what we do with beauty."

Somehow we dodged the 747s and Bill put us on a strip where, as always, he knew everyone and everyone shut up and listened when he started to talk. And there we said good-bye, he to refuel and then take off again, seething at the smog, and climb back to his blessed deserts and mountains and clear lakes and patterns on the land.

Bill Garnett is a throwback to the barnstormers. He flies where he wants, setting down where the evening catches him. But he offers a lot more than a few acrobatics and a two-buck ride over the north forty. He finds and captures and sells a special look at our planet. And as I watched the little silver plane take off and climb through the smog, seeking the clear places again, I was sorry I wasn't aboard.



In a small corner of northern Michigan farmland, one glowing tree points the way to autumn.

Grain harvest in hilly country near Rio Vista, California, leaves a pattern like a grounded comet.

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*Suggested 1977 retail price, P.O.E. Transportation, local taxes, and dealer charges additional.

gets 24 mpg on the highway and 14 in the city which is truly extraordinary when you consider it's the fastest production car Porsche ever built. (EPA estimates for standard shift. Mileage may vary depending on condition of the car, optional equipment, as well as how you drive.)

Also, both cars utilize a unique transaxle system with the engine mounted over the drive wheels. This not only reduces the weight (because there's no long drive shaft), but it keeps the transmission and drive train in one place for even power transfer and it concentrates the weight over the drive wheels for added traction.

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A dedication that has a lot to do with pride. Regardless of price.

DRIVE ONE OF OUR LEGENDS

PORSCHE + AUDI

By Martin Zucker

A great collection of tiny artistry—how it was made

Arthur Gilbert amassed a collection of rare micromosaics to equal that owned by the Hermitage—and has given most of it away

As was his habit on Saturday afternoons a dozen years ago, Arthur Gilbert, collector of things beautiful, unusual and usually expensive, was making the rounds of the antique dealers in Los Angeles. In the Marvin Newman Gallery he came across a diminutive picture—it was six by nine inches—of a dashing cavalier courting a lady. A miniature oil painting, Gilbert thought. But no. Looking closer, he discovered that it was a mosaic with thousands of tiny colored pieces compressed within that small area. He was amazed by the fine detail, the delicate gradations of shading and color, and the fitting of pieces so skillfully accomplished that he could barely tell that it was, in fact, a mosaic.

What technique and patience went into such work, he thought, as he purchased that item and another like it. How, he asked, were they done and by whom?

Gilbert got no answer in that gallery, nor in others he visited, nor in art reference books, nor from inquiries at museums. Intrigued, he turned detective and launched an intercontinental investigation into the mysterious mosaic. He was hooked on what he later would learn was a forgotten art form—18th- and 19th-century Roman micromosaics, wherein Italian artists, working with up to 1,400 tesserae (pieces) of colored ceramic to the square inch, had masterfully matched the skill of an oil painter's brush.

Today, after a relentless search, Gilbert has amassed possibly the largest private collection in the world of these miniature mosaics. Although by his own admission he is "hardly an art scholar," he has learned so much that he ranks as one of the few authorities on the subject. While not boasting, he believes that only the Hermitage in Leningrad has a collection to rival his, and that probably only Madame E. Efimova, the curator in charge of it, shares his knowledge of these little-known works of art.

The micromosaics, along with a sister collection of larger Florentine mosaics and an extraordinary collection of Paul de Lamerie and Paul Storr silver, have been given by Mr. and Mrs. Gilbert to the Los Angeles County Museum of Art and are on display there until July 10. The exhibition will travel to the High Museum of Art in Atlanta, the Seattle Art Museum and the Virginia Museum of Fine Arts in Richmond. Kenneth Donahue, director of the Los Angeles County Museum of Art, describes the acquisition as "a totally unique gift, for there is nothing in the world comparable to the Gilbert mosaic collection outside the Hermitage, and the silver is the most important private collection of Georgian silver in the United States."

The collector, too, is unusual. Arthur Gilbert and his dress-designer wife Rosalinde established a popular and profitable fashion line in prewar England. After the war, they decided to chuck it in for sunnier climes and transplanted themselves to Los Angeles, where Gilbert started investing in property. As he tells it, in the boom that came to pass he "made more good investments than bad ones."

A nonsnobbish lover of collecting

At 64, he is tanned and fit from daily tennis and jogging over the grounds of his museumlike villa overlooking the west side of Los Angeles. He is a direct man who speaks his mind with a British accent only slightly faded by nearly 30 years in the California sun. Out of gratitude to that sun and "as a Londoner who knows what lousy weather is really like," he conducts most of his business dressed in tennis clothes and resents "having to put on pants for meetings at banks, museums and the like."

First and foremost, Gilbert considers himself a collector. "I love collecting," he says, "whether it's buildings, stained glass, Georgian silver, Tudor-period furniture or mosaics. I glory in the chase, in the exhilaration of going after a deal or a fine piece of art. But," he adds, his voice taking on an edge of annoyance, "a lot of collectors are snobs. They will buy something because it has Mr. Picasso's name on it. I

Note the two-by-four-inch martial micromosaic panels between columns of this grandiloquent clock commissioned by Pope Pius VII for Napoleon.

A connoisseur's eye for the unusual, and an unusual idea of "business" dress: Arthur Gilbert at home.

don't go that way. If I like something, I like it. That's what happened with the mosaics. Nobody knew anything about portable mosaics, let alone was collecting them. You would mention mosaics to people and they'd say, 'Oh yes, you mean those old Byzantine things stuck in floors, ceilings and walls.' There was scant literature. There was hardly anything in sales. Here I had the money and could go out and buy anything I wanted, but where to start?"

In New York and London, from Russia to Rome, walking miles from one antique dealer to the next, visiting this museum and that museum, and making hundreds of calls, Gilbert managed over the years to recover the art and uncover some of its mystery.

The micromosaics were made primarily in Rome from the mid-18th century to the turn of the 20th. There are no known records to indicate when the technique was first used, what prompted its development or who the original masters were. It emerged from the Vatican School of Mosaic, originally formed in the late 16th century to reproduce in "eternal stone" the pictorial masterpieces of Vatican art. As time went on, mosaics began to be used more extensively and workshops sprang up around Rome. Smaller and smaller incrustations began to be used for decoration of fine furniture and jewelry for the rich, for ornate trinkets sold to Christian pilgrims, and for more independent artistic compositions.

Through visits to the Vatican School, Gilbert learned firsthand about the state of the art. The method he saw in use was first to draw the outline of the picture on a bed of secret-blend plaster and stucco. Then the artist-craftsman melted together the required amounts of the basic colors, formed them into long enamel threads, filed them to proper thickness, broke off individual tesserae, shaped them on a lathe, and fixed them into the stucco base with tweezers. Finally, an involved process of waxing to fill the tiny crevices and several rounds of smoothing and polishing to bring out a perfect gloss.

"OK," says Gilbert, "that's how they do it now with half-inch pieces. But I've still not found any answers as to how they put in more than 1,000 tesserae to the square inch and achieved all that remarkable control that you see only in the finest oils. There is nobody working that small and fine today in this age of microcircuitry, where it might be more manageable.

"These people did it 150 and more years ago; imagine the time and patience that went into a mosaic painting measuring over five feet by two. We know only that they worked with magnifying glasses and jeweler's tweezers. Even when masters had craftsmen

A former Associated Press reporter in Europe and the Middle East, the author free-lances in Los Angeles.

The 11 inlaid panels of marble and semiprecious stones were placed in English George II chest of ebonized and gilt wood by an unknown 18th-century craftsman of the Grand Ducal Workshop.

A Roman micromosaic classical head of Bacchus, created by Clemente Ciuli in 1804, adorns the top of a gold-and-enamel snuffbox. With all its detail, it measures only 3¼ inches across.

working under them, some of those pieces took years to complete."

Not until 1970 did Gilbert find literature on the micromosaics. It was a catalog on the Hermitage collection, written in Russian by the curator, Madame Efimova. Gilbert had it translated. Pieces in the collection had been purchased by sundry Czarist royalty, who fancied the work, as did many of Europe's ruling class. In many cases, he found, there were similar pieces by the same artist in both collections.

The work, Madame Efimova suggested, embodies the ideal formulated by Vasari, the historian of Italian Renaissance art: "The deserving mosaic should be distinguished by its clarity of construction, by the shades and smoothness of transition between colors; it should be worked with the greatest consideration [to] appear as a picture and not as an incrustation."

Gilbert visited the Hermitage in 1973 and saw the Russian collection, escorted by Madam Efimova.

Micromosaics comprise the greater part of the 200-piece Gilbert collection. The rest are of the Florentine type, which differ in that they are made of semi-precious stones such as lapis lazuli, onyx, jasper, sardonyx, chalcedony, coral and amethyst, smoothly fitted against each other as in a tight jigsaw puzzle.

The Florentine style emerged from the *Opificio*

delle Pietre Dure, or workshop of semiprecious stones, opened in Florence in 1580 by the Medici family. The workshop still exists today as the *Museo dell' Opificio delle Pietre Dure.*

A good deal of the background on pieces in the Gilbert collection was found in Italian archives by Alvar Gonzalez Palacios, a Cuban art authority specially commissioned by the Los Angeles County Museum. His catalog on the collection is now the most complete publication in English on post-Renaissance mosaics.

One of the highlights of the collection is the triumphal clock (p. 84) created by Giacomo Raffaelli, a celebrated master of both the Roman and Florentine mediums. The piece, commissioned by Pope Pius VII as a gift for Napoleon in 1804, demonstrates Raffaelli's multiple virtuosity as a carver of marble and semiprecious stone (the bases, columns and arch), as an artist of micromosaics (the two-by-four-inch panels on each column), and as a caster of bronze (the statuettes representing Mars and Victory). The clock, three feet high, is signed by the great clockmaker "Breguet à Paris." Napoleon gave it to Josephine.

The ebonized and gilt wood English cabinet (p. 87) features a center door and ten drawers, all adorned with inlaid panels of Florentine marble mosaic typically produced during the early 18th century. The Ionic columns are inlaid with Porta Santa Rara marble. The cabinet, an important example of George II style, stands seven feet by four by two.

A delicate micromosaic classical rendering of the head of Bacchus (opposite) tops a gold and enamel snuffbox measuring but 3¼ inches in diameter. It is signed by C. Ciuli, a mosaicist who managed his own workshop in early 19th-century Rome. The box, bought from a London dealer, came with a letter dated 1811. The letter said the box was a gift of Pope Pius VII and the writer was presenting it in turn to a Paris banker in gratitude for financial favors.

An enchanting mosaic painting

The Temples of Paestum (pp. 90-91), a mosaic painting, so enchanted Gilbert that he bought two of the five known versions. The work, measuring 64 by 19 inches, is a sweeping landscape signed by Gioacchino Rinaldi, one of the Roman masters of the early 19th century. A version is owned by the Hermitage and Madame Efimova extols its "high level of technical mastery" that "creates an impression of an oil painting." After acquiring the first piece for the museum, Gilbert heard of a second one coming up at auction in London. "I jumped at the possibility of having one of these marvelous pieces to enjoy in my home," he says.

Another striking mosaic—perhaps the most impressive of all—is the *Panoramic View of Rome* (pp. 90-91), a one-of-its-kind that took an uncelebrated artist named Antonio Testa 20 years to complete. Measuring 53 by 20 inches, it is an exact copy of a 1765 panoramic sketch of the city, with some zest added by Testa in the form of lively figures and animals in the foreground. Gilbert bought the piece from a Rome dealer who was going out of business. "I saw the detail and couldn't believe it was a mosaic," he says. "There is nothing at all to match it."

During his active pursuit of mosaics, Gilbert knocked on many an odd door. Once he found a fine micromosaic portrait of Titian's daughter Lavinia in a British gunsmith's shop. Another time, he heard of a Vatican cardinal who owned a magnificent mosaic table top and wanted to give it to the Pope. Gilbert quickly arranged a meeting and acquired the table for his collection, making in return a handsome donation to the Vatican. And one time, in a cluttered London secondhand shop, he found a miniature masterpiece and bought it for $20.

Asked about prices, Gilbert says, "Who knows how much they are really worth? I paid whatever it took to buy them." The range, he admits, runs from $20 up to $75,000 for the Napoleon clock. The worth of the total collection is something he prefers not to discuss in detail. "Substantial" is his only answer.

Arthur Gilbert talks of his mosaics with the pride of a new father. He fondles the pieces with love for the beauty and awe for the technique. When a part of his collection was displayed at the Los Angeles County Museum in 1975, Gilbert frequented the exhibition every weekend for six weeks, personally offering a magnifying glass and explanation to interested visitors. "I wanted to make sure people would experience the beauty and detail as I have," he says.

Filippo Puglieschi made this exquisite example of the mosaicist's art in Rome in early 19th century.

Classically idyllic scene, 64 by 19 inches, *The Temples of Paestum* is work of Gioacchino Rinaldi, dated 1800-05. There are five known; Gilbert bought two.

A grand tour-de-force display of what the Roman masters of the art were capable of is Antonio Testa's 53- by 20-inch *Panoramic View of Rome.*

Gulf
Gulf

"Friends ask me if we cap natural gas wells instead of sending the gas someplace useful."

"I get questions like that every day," says Gulf Offshore Operations Manager Roy Tillerson.

"People say, 'Is it true there are capped natural gas wells when people need gas so badly?'

"I have to say yes, because there are. But it's not that simple.

One well isn't a field

"When a company thinks there's natural gas down there, it drills an exploratory well. But one gas well doesn't make a gas field. If you find gas with the first well, you have to cap it and drill maybe a dozen more, to see how much gas there is.

"People say, 'If you know there's gas, why not just build a pipeline to where it can be used?'

"Gulf has hundreds of gas wells in the Gulf of Mexico, working at full capacity."

"And I say, a gas field could cover anywhere from one square mile to a thousand. Until you know how big the field is, you don't know how big a pipeline to build. In many cases, federal law doesn't allow pipeline construction until it can be proved there's enough gas in the field to justify it.

"Even if you were allowed to build unlimited pipelines, the cost of the pipelines would send the price of gas out of sight. For instance, Gulf just finished a 60-mile gathering pipeline that cost $25 million. It was built to serve as many as 36 wells. You can see that a separate pipeline for each of those wells would be astronomically expensive.

"This is a capped well. But one well is a long way from bringing in enough gas to make a pipeline practical."

Working full time

"So we cap wells until we find enough natural gas to make it practical to pipe it out.

"Gulf already has thousands of wells producing all the natural gas they can. The challenge we're facing now is to find more natural gas, and ship it to consumers the cheapest way."

Gulf

Gulf people: meeting the challenge.

Gulf Oil Corporation

By Jeannette Mirsky

Discovering ancient treasures in 'Caves of the Thousand Buddhas'

Intrepid Sir Aurel Stein knew no Chinese, but knew a bonanza when he found it hidden away at a remote desert crossroads

"On the almost perpendicular conglomerate cliffs, I caught sight of the first grottoes. A multitude of dark cavities, mostly small, was seen here honeycombing the somber rock faces in irregular tiers from the foot of the cliff, where the stream almost washed them, to the top of the precipice. . . . In bewildering multitude and closeness the lines of the grottoes presented their faces, some high, some low, perched one above the other without any order or arrangement in stories.

"Rough stairs cut into the cliff and still rougher wooden galleries served as approaches to the higher caves. But many of these seemed on the point of crumbling away, and high up in the topmost rows were manifestly shrines which had become quite inaccessible. . . . I noticed that the fresco paintings covered the walls of all the grottoes. The 'Caves of the Thousand Buddhas' were indeed tenanted by images of the Enlightened One himself."

It was March 16, 70 years ago. Thus Aurel Stein (soon to be Sir Aurel) described his first view of Ch'ien-fo-tung, Caves of the Thousand Buddhas, the cave-temples near the oasis of Tunhuang. Its ancient place name of Sha-Chow, City of Sands, speaks of forbidding, desolate surroundings just as the lavishly decorated grottoes indicate that for long centuries its

In Kashmir, 1912, Stein became Knight Commander of Indian Empire, by order of King George V.

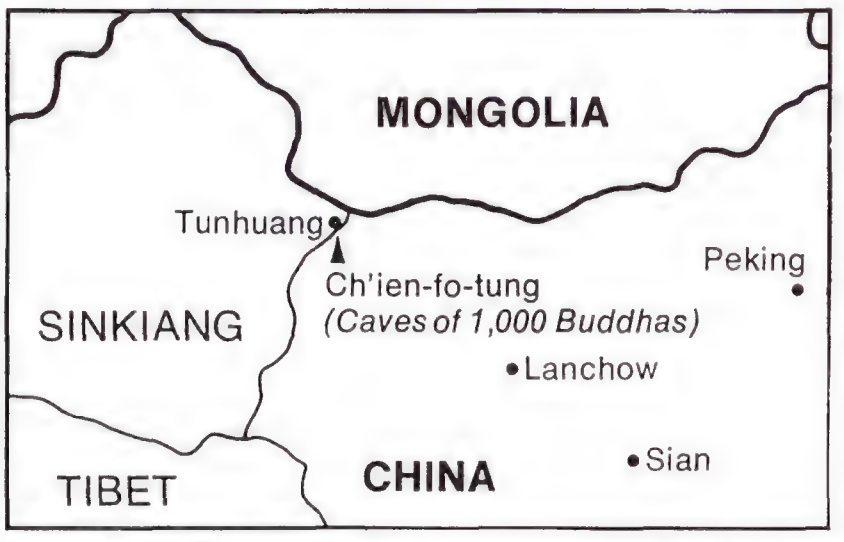
Two forms of Avalokiteśvara, Indian Bodhisattva of mercy, were painted by Chinese artists.

Bundles of scrolls, in the original wrappers that had protected them for nearly a millennium, were unwrapped for examination after removal from walled-up temple library at Tunhuang.

location had been strategic to both trade and religion.

Who was Aurel Stein? Where did he come from. Why and how had he made his way to Tunhuang? What *was* Tunhuang? What rumor had lured him from India to distant Kansu? The questions arise because time has erased the memory of that discovery, which is adding significantly to knowledge of China's past.

The Hungarian-born Stein (1862-1943), a scholar and archaeological explorer, was the hardiest of a handful of pioneers who, at the beginning of this century, probed Central Asia to trace the ancient caravan routes known collectively as the Silk Road. From about 100 B.C. transcontinental routes had linked China and the West. Trade carried precious and desirable silk overland from China to Persia and Byzantium, and pilgrims to China had carried Buddhist scriptures and the Greco-Buddhist image of the Enlightened One from India, where he lived and taught.



Caves at Tunhuang are on the ancient Silk Road that brought Buddhism from India to China.

It was on his second expedition, 1906-08, that Stein brought the attention of Europe to the secret treasure of Tunhuang. His journey there was arduous but of a kind singularly appealing to him. Starting from Kashmir, he made his way over awesome, high Hindu Kush passes and crossed the Pamirs—which Marco Polo had described as the Roof of the World—to begin archaeological reconnaissance of Chinese Turkestan.

At Kashgar, helped by the British Resident, he had the good fortune to engage as secretary Chiang-ssŭ-yeh, whose wit and courage, companionship and devotion lightened the hardships and loneliness of field work in the Taklamakan desert. Stein voiced his bitter

This article is adapted from Jeannette Mirsky's biography, Sir Aurel Stein, *being published this month by the University of Chicago Press.*

Look closely at any woman. You see the outer expression of some inner mood of soul.

So, too, does every great perfume have a soul which reflects itself outwardly.

It may be the inwardly controlled sensuality of Shalimar, outwardly expressed as adventure.

Or the inner warmth of a sunrise as in Guerlain's newest fragrance, Parure, outwardly expressed as radiant beauty.

Each Guerlain fragrance is meant to be worn body and soul.

GUERLAIN MAKES FRAGRANCES FOR BODY AND SOUL.

Wang Tao-shih was Taoist monk who guarded the secret library and opened it up for Stein.

Chiang-ssŭ-yeh, Stein's Chinese secretary, helped talk the monk into parting with scrolls.

regrets at his total want of Chinese; he was dependent on Chiang and paid tribute to him.

The Taklamakan desert, where Stein sought to fill in a forgotten chapter in Asia's pre-Muslim past, needs an introduction. An 800-mile basin from east to west holds a sea of sand. Fierce winds move its wavelike sand dunes. The islands within it are hideous salt-crusts and clay capriciously carved by the winds. The Taklamakan suffers the worst extremes of climate.

Lofty, snow-covered mountains ring the Taklamakan on three sides: the Pamirs on the west, the Tien Shan (Celestial Mountains) to the north, and the Kunlun to the south. They hold immense reservoirs of snow and ice which, melting, feed rivers, furnishing life-giving water for oases spaced out along the desert's perimeter. The rivers without exception flow helplessly into the desert to perish there.

Artistic riches in a wasteland

The oases are stations along the caravan routes and define the two roads connecting east and west. One runs along the northern edge of the Taklamakan at the foot of the Tien Shan; the other skirts the southern. At Tunhuang the roads meet and enter China; there, too, the road from Tibet to Mongolia crosses.

The Tunhuang cave-temples, vibrant with art, had been mentioned to Stein by a member of a Hungarian geological expedition to Chinese Turkestan, and he planned a visit to them as a bit of tourism. His main task continued to be tracking down and excavating sand-buried sites well within the Taklamakan, where rivers once had sustained hardy settlements. Rawak, Dandan-Ouliq and Niya yielded hundreds of documents on wood. Before the Chinese invented paper, they had written on bamboo bark. It was Stein who found the earliest specimen of paper, dated A.D. 105.

Enroute to Tunhuang, at an oasis, Stein was told that a Taoist monk, the self-appointed guardian of the cave-temples, recently had found a mass of papers inside a side chapel bricked up at some date long ago.

The news was electrifying. But it did not deflect Stein from continuing his systematic search for wooden records contained in the rubbish heaps of the watchtowers of the long-forgotten precursor of the Great Wall. This, an embankment 100 miles long, had been constructed in the second century B.C. The Han Emperor, Wu-Ti, ordered it in order to protect China's new commercial and political expansion into Central Asia from raids by the Huns.

Not until mid-May did Stein establish his camp at the caves. Caution balanced his eagerness: the cave-temples were still objects of veneration. He watched the long procession of carts bringing people there on their annual pilgrimage. Only when the tide of wor-

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The British Museum

On a silk banner, Bodhisattva Mañjuśrī is shown seated on white lion, open-jawed as if roaring.

shipers receded did Stein have his tent pitched on a little grass-covered plot in front of the caves. Chiang made himself cozy nearby in a cool room at the foot of a three-story-high seated Buddha.

Together they went in search of the guardian, the reputed discoverer of the hidden cache. Wang Tao-shih was a queer person; Stein found him shy and nervous with an occasional look of cunning.

This first impression was diluted when Stein learned the monk's background and nature. Poor, almost illiterate, he had begged his way across half of China and, eight years before, had settled at the cave-temples. There he had found his life's mission: to restore a temple (it measured 54 feet by 46 feet) to what he conceived to have been its original glory.

Begging to finance a noble mission

To pay laborers to clear a 40-foot passageway choked with high drift sand, he had made regular begging tours. He proudly showed Chiang the list of sums he had collected, along with meager amounts he had spent on his modest living.

Everything hinged on Wang. After the first encounter, while ostensibly busy photographing, Stein reconnoitered. He was dismayed to notice that a rough wooden door that had closed the entrance to the hidden recess had been replaced by a wall of brick. To Stein it was essential that he see the hoard in its place of deposit: the rules of archaeology demanded it.

How was he to get access? He entrusted this delicate negotiation to Chiang's tact and enthusiasm. But Wang was not to be coaxed into any promises.

During their leisurely conversation, Wang told Chiang that the manuscript find had been reported to the viceroy at Kansu and a few rolls of Chinese texts sent as specimens. When the officials were told that the entire find would fill at least seven large carts, they thought the transport cost prohibitive. The collection was left undisturbed in Wang Tao-shih's care.

Such lack of interest in the high officialdom hardened Stein's determination: scholarship must be served by rescuing the collection from its secret prison.

With Chiang he called formally on Wang and asked to be shown the restored cave temple. Wang was at once proud of his efforts and serene that by them he had won religious merit. Watching him, listening to him, Stein was reminded of the curious mixture of pious zeal, naive ignorance and astute tenacity so characteristic of the early Chinese Buddhist pilgrims who had overcome great difficulties to visit India.

He chose not to comment on the unplastered brickwork barring entry to the hidden chapel, but rather to give close study to the spirited frescoes with which a local artist had decorated the newly restored temple

loggia. They all illustrated familiar scenes from the legendary travels of Hsüan-tsang, a saintly, influential seventh-century pilgrim.

Hsüan-tsang's account of his travels to India had become a kind of Baedeker to Stein; it had been his guide in his search for ancient Buddhist sanctuaries. Stein had claimed Hsüan-tsang as his patron saint.

Now, studying the newly painted frescoes, he picked out one that he could use as a text. It showed Hsüan-tsang and beside him his faithful steed laden with bundles of manuscripts. They stood waiting beside a rushing river through which swam a huge turtle sent to ferry pilgrim and horse safely over the angry water. The picture recalled the pony-loads of sacred books and relics the holy pilgrim had brought back with him from India. Later, Stein spoke eloquently of how this transmission had shaped Chinese Buddhism.

It was a hint; it pointed a moral. Stein hoped Wang would understand. He wondered how long he would have to wait for the hint to be effective.

Not long: that very night Chiang groped his way to Stein's tent clutching a bundle that Wang had secretly brought to him. To Stein, well trained in paleography, both the writing and the paper looked authentically old, but because he could not read Chinese, Chiang carried them back to his den for study.

A hint from a patron saint

When at daybreak he returned, wonder and triumph shone on his face. The colophons declared the roll to have been brought from India and translated by Hsüan-tsang himself. The heavens had spoken. Could Wang disregard this celestial fiat? Was it not a clear sign that Stein's patron saint was giving his blessing to Stein's request to see the hidden treasure?

The quasi-divine hint overcame Wang's apprehensions. That afternoon in the siesta hour when prying eyes were shut, he opened the recess to Stein and Chiang. They peered into the blackness.

Illuminated by Wang's little lamp, Stein saw "a solid mass of manuscript bundles rising to a height of nearly ten feet, and filling, as subsequent measurement showed, close on 500 cubic feet. The area left clear within the room was just sufficient for two people to stand in." Obviously, no examination of the manuscripts would be possible in that black hole.

A small side room complete with door and paper-covered windows offered a reading room safe from any curious worshiper. To examine the contents of the small mountain of texts was staggering. The rolls, a foot wide and ten yards or more in length, made scrutiny slow, difficult and tiring. As Wang's courage rose he dragged out load after load. On Chiang fell the reading of the Chinese rolls—but his studies had not

Sword-branishing Virūpākṣa, "Guardian of the West," standing on a nude, dog-faced demon.

e British Museum

The thousand-Buddha caves

included Buddhist writings and Stein, alas, was familiar with them only in their Indian form.

Suddenly, on the reverse side of a Chinese roll, Stein saw the cursive Indian Brahmi script familiar to him. It offered absolute proof that some of the manuscripts belonged to the early centuries of the Christian era when Indian writing and some knowledge of Sanskrit still prevailed in Central-Asian Buddhism. It was proof, too, of the close, vital tie between Buddhist monasteries in India and the Tarim Basin. Stein's archaeological conscience was satisfied.

The dryness of the recess cut into the living rock and sealed by the wall of drift sand was perfect. It was an ideal repository. In addition to documents, it had preserved exquisite religious banners—paintings done on transparent silk gauze of remarkable fineness. These had been carelessly folded and jammed into packets; Stein dared not try to straighten them, but by lifting a fold here and there he saw they were as superb as the frescoes that everywhere delighted the eye.

The long first day's work resulted in a pile of manuscripts and painted fabrics stacked on one side of the reading room. Under the euphemism of further study, Stein bought time. Both men were physically spent from unrolling and rolling up miles of documents, and emotionally exhausted at the unexpected treasures that had passed through their hands. Yet when they stepped outside into the loggia, they had to appear calm and nonchalant to Wang. Stein made it a point to talk quietly of Hsüan-tsang, to reinforce Wang's conviction that the blessed pilgrim had interceded to have the manuscripts freed from their prison.

Day after day what Stein called "this curious digging" was vigorously pursued. The daylight hours fluttered by in a kind of blindman's choice of bundles and rolls, and each night the day's harvest was carried to Stein's tent. Systematic selection was impossible. Stein aimed to amass what he could and trust to luck.

Centuries of digging and carving in a high cliff face produced the honeycomb of Tunhuang caves.

An embarrassment of riches

His meticulous work habits insisted that the recess must be cleaned of its contents so that nothing unusual would escape his examination. It was thus at the very bottom, wrinkled and flattened under the weight of the thousands of stacked rolls, that he found more silk paintings and among the embroidered pieces a magnificent one depicting a life-size Buddha flanked by Bodhisattvas.

Stein gladly would have taken the whole collection, but Wang demurred; his excuse was that the sight of the carts necessary for transport would arouse local suspicions. Stein, however, felt that Wang could not bear being stripped of what he had come to think of as part of his life. The archaeologist, too, was uneasy because his ignorance of Chinese prevented his choosing knowingly from the embarrassment of riches.

It was mid-June when Stein's caravan was ready to leave. Five carts were needed to carry the 24 cases of manuscripts and the five filled with silk paintings, embroidered pictures and other precious odds and ends. Stein presented Wang with four horseshoes of silver, equal to about 500 rupees, a pittance, but to Wang a handsome contribution to his restoration fund.

In all this Stein's motivation was clear: to recover all materials that bore true witness to Man's past and bring them into the mainstream of Western scholarship. Unlike his contemporaries who dug in Europe's backyard—Crete, Egypt, Mesopotamia—Stein searched the moonscapelike Taklamakan. He unearthed docu-

ments of unique value to Chinese historical studies. Stein was the Lone Ranger of archaeology.

The science was still a Western discipline. Today, when Chinese archaeology is spectacularly successful, it is easy to forget that until the 1920s Chinese scholars had not used the spade to investigate their own past. Yet ten years later they were calling Stein a "bandit" who had kidnaped their ancestral records.

Other Orientalists quickly followed Stein to Tunhuang. Its more than 25,000 items contained within the hidden recess are scattered now—London, Paris, Leningrad and Peking. Less and less has their dispersal had the tragic impact it once had, for photography and microfilm are enabling each of the centers to have copies of all the Tunhuang documents.

The manuscripts span 600 years, from A.D. 406 to 995, and had lain hidden and forgotten for almost 900 years. It was claimed that "such an unbroken sequence is hardly to be paralleled in any other literature of the past."

A trio of well-preserved Bodhisattvas, painted on silk, includes Avalokiteśvara in center, holding a flask and lotus bud. The pouting figure at right is puzzling because features are non-Chinese.

The British Museum

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Your home, apartment or office can become an action entertainment center with America's first commercial-home pinball machine.

It's you against a computer. And the action and excitement from Fireball, your own computerized pinball machine, is nothing short of spectacular.

Fireball's computer replaces many of the mechanical, scoring, conventional electronics and sensing devices of a standard pinball machine. It's a dramatic change in pinball devices and the start of a new consumer electronics revolution.

DESIGNED FOR ACTION

Fireball contains flippers, bumpers, thumpers, flashing lights, sounds and a full-sized playfield. The glass covering the playfield is safe, shatterproof and specially tempered.

From one to four players can compete. Turn the unit on and simply program the computer with the number of players by pressing the start button up to four times. Each player's score is kept separately in a memory and appears on the display for each player's turn and at the end of the game.

The ball is automatically ejected and you pull the plunger to project it into action. The ball bounces from side to side from bumper to thumper. Lights flash and the scoring begins. You use the separately controlled flippers by pressing the flipper controls on the sides of the playfield which are low enough so that even a five year old can reach them.

Flip a switch and Fireball can be programmed for beginner or advanced skills although pinball is the only game everybody knows how to play within seconds after they step up to a machine.

"WE'RE IN THE MONEY"

The thrill of winning a bonus score or extra ball is enhanced by Fireball's songs and scoring tones. The computer's synthesizer plays seven songs—everything from "We're in the Money" when an extra ball is awarded to "The Party's Over" when the game ends. Various scores sound five additional tones making the game a total sight and sound experience. A volume control lets you keep it loud at a party or turned down in quieter surroundings.

COMMERCIAL PARTS AND FEATURES

Fireball contains the same heavy-duty devices and scoring features as a commercial pinball machine. The game has a tilt feature—tilt Fireball and a tilt sign glows and the scoring stops. The full-sized, full-color commercial playfield even has a special friction silk-screened surface so the ball will roll and not slide. Fireball differs from an arcade unit only by the start button which has replaced the coin slot and its new electronics. In fact, all future commercial machines will resemble Fireball within a year.

MANY NEW FEATURES

Fireball's computer is as powerful as the million dollar IBM computer sold in 1964. The solid-state LED scoreboard replaces the old electromechanical pinball scoring wheels so Fireball's backboard is thinner and its scoring more reliable. Its memory not only keeps track of everybody's score but the exact playfield configuration and extra bonus balls—something present arcade games can't do.

The American-made Bally Fireball—the first computer pinball machine designed for both home and office entertainment centers.

Although the playfield is just as large as the commercial machines, the entire unit has less weight, less bulk, and practically no service requirements making it ideal for the home or office. It takes up a space 2 feet by 4 feet and weighs 160 pounds.

HOW TO JUSTIFY PINBALL (TAKE THIS TEST)

If you paid more than $600 for either your TV set, stereo system or pool table—you should consider a pinball machine. You'll have more fun and action than watching TV, listening to your stereo or playing pool.

And when guests pop in, your Fireball will be the talk and highlight of their visit. Your TV and stereo are used primarily for private viewing or listening. Your pinball machine is for all times—from your personal family enjoyment to big parties. It's the great new idea in home entertainment.

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Consider Fireball for your office as either an executive toy or a free new benefit for your office or factory employees during their breaks. You get both an investment tax credit and depreciation. Fireball combines participation, action and entertainment. A pinball machine is so intriguing that people pour dollars into them at arcades. It requires skill, sharpens responses and can become the single most talked about entertainment product in your home or office.

LASTING PLAY VALUE

Fireball, unlike the new TV games, is partially a game of chance and thus can never be mastered. Even an experienced professional can lose to a youngster. A daughter can beat her father, grandma can beat grandpa and the surprise of an upset is what adds to the long lasting play value. A professional pinball machine is an amusement game that you rarely get tired of—no matter how good you get, no matter how long you've played. Ask any arcade operator. His customers will tire of his video games which he continually rotates with newer models but his pinball machines are played and played and played.

Don't be confused. There are other games made by toy designers selling for one half the price. Fireball is not a toy and is built by a company that specializes in pinball machines. With all its sophistication it is the most service-free, quality pinball machine ever produced.

When you buy an expensive product you must be absolutely satisfied that you get the service and a solid company standing behind your purchase for many years to come. Fireball is backed by a substantial company, Bally—in business since 1931 and now the world's largest manufacturer of coin operated amusement games. JS&A is America's largest single source of space-age consumer products and also a substantial company—further assurances that your investment is well protected.

A FRANK DISCUSSION OF SERVICE

Fireball is a solid-state computer with its electronics condensed on integrated circuits—all hermetically sealed and all pre-tested for a lifetime of service. Fireball is also self-diagnostic. Let us say something goes wrong with the system. Simply press the test button on the back panel of your machine and the exact problem is displayed on your scoreboard in digits. Check the instruction booklet and simply remove the designated plug-in circuit board, light bulb or part and send it to the service department closest to you for a brand new replacement. Even your TV or stereo isn't that easy to repair.

Please don't think service requirements are common. They're not. But we wanted to assure you that service was such an important consideration in its design that Fireball practically repairs itself. And any defective component will be replaced free-of-charge during its one year limited warranty.

SHIPPING AND THE TRIAL PERIOD

Each Fireball comes in two sections with four metal legs. The two sections quickly bolt together with the top portion also plugging into the bottom to make all electrical connections. Within minutes after it arrives, your unit is ready to operate.

Attach the metal legs, plug it in and start playing. Don't even read the instructions on how to play it—you should know how within minutes. Then after you've played Fireball for awhile, go to your local arcade and play a standard $1500 pinball machine. It's only then that you'll realize how much more value you are getting with Fireball.

But let's be realistic. What if you don't like what you get? Simple. A toll-free call to JS&A and we'll arrange for the pick-up of your unit and we'll pay all the pick-up and return costs. And you can play Fireball for one month before you make up your mind.

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The cost for your own pinball machine is $795 (Illinois residents add $39.75 sales tax) plus the freight which you pay upon receipt and which will run approximately $34 from our facilities in Northbrook to Los Angeles or less if you live closer. You can order Fireball with any major credit card by calling our toll-free number or you can send your check for $795 to the address shown below. We will then promptly ship your unit and advise you.

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Text and photographs by E. Richard Sorenson

Growing up as a Fore is to be 'in touch' and free

Film studies of a hunting-gardening culture in Papua New Guinea disclose remarkable child-rearing practices

Untouched by the outside world, they had lived for thousands of years in isolated mountains and valleys deep in the interior of Papua New Guinea. They had no cloth, no metal, no money, no idea that their homeland was an island—or that what surrounded it was salt water. Yet the Fore (*for'ay*) people had developed remarkable and sophisticated approaches to human relations, and their child-rearing practices gave their young unusual freedom to explore. Successful as hunter-gatherers and as subsistence gardeners, they also had great adaptability, which brought rapid accommodation with the outside world after their lands were opened up.

It was alone that I first visited the Fore in 1963—a day's walk from a recently built airstrip. I stayed six months. Perplexed and fascinated, I returned six times in the next ten years, eventually spending a year and a half living with them in their hamlets.

Theirs was a way of life different from anything I had seen or heard about before. There were no chiefs, patriarchs, priests, medicine men or the like. A striking personal freedom was enjoyed even by the very young, who could move about at will and be where or with whom they liked. Infants rarely cried, and they played confidently with knives, axes and fire. Conflict between old and young did not arise; there was no "generation gap."

Older children enjoyed deferring to the interests and desires of the younger, and sibling rivalry was virtually undetectable. A responsive sixth sense seemed to attune the Fore hamlet mates to each other's interests and needs. They did not have to directly ask, inveigle, bargain or speak out for what they needed or wanted. Subtle, even fleeting expressions of interest, desire and discomfort were quickly read and helpfully acted on by one's associates. This spontaneous urge to share food, affection, work, trust, tools and pleasure was the social cement that held the Fore hamlets together. It was a pleasant way of life, for one could always be with those with whom one got along well.

Ranging and planting, sharing and living, the Fore diverged and expanded through high virgin lands in a pioneer region. They hunted out their gardens, tilled them while they lasted, then hunted again. Moving ever away from lands peopled and used, they had a self-contained life with its own special ways.

The underlying ecological conditions were like those that must have encompassed the world before agriculture set its imprint so broadly. Abutting the Fore was virtually unlimited virgin land, and they had food plants they could introduce into it. Like hunter-gatherers they sought their sources of sustenance first in one locale and then another, across an extended range, following opportunities provided by a providential nature. But like agriculturalists they concentrated their effort and attention more narrowly on selected sites of production, on their gardens. They were both seekers and producers. A pioneer people in a pioneer land, they ranged freely into a vast territory, but they planted to live.

Exploring, two youngsters walk confidently past men's house in hamlet. Smaller women's house is at right.

Close, constant body contact, as between this baby and older girl, creates security in Fore children.

Cooperative groups formed hamlets and gardened together. When the fertility of a garden declined, they abandoned it. Grass sprang up to cover these abandoned sites of earlier cultivation, and, as the Fore moved on to other parts of the forest, they left uninhabited grasslands to mark their passage.

The traditional hamlets were small, with a rather fluid system of social relations. A single large men's house provided shelter for 10 to 20 men and boys and their visiting friends. The several smaller women's houses each normally sheltered two married women, their unmarried daughters and their sons up to about six years of age. Formal kinship bonds were less important than friendship was. Fraternal "gangs" of youths formed the hamlets; their "clubhouses" were the men's houses.

During the day the gardens became the center of life. Hamlets were virtually deserted as friends, relatives and children went to one or more garden plots to mingle their social, economic and erotic pursuits in a pleasant and emotionally filled Gestalt of garden life. The boys and unmarried youths preferred to explore and hunt in the outlying lands, but they also passed through and tarried in the gardens.

Daily activities were not scheduled. No one made demands, and the land was bountiful. Not surprisingly the line between work and play was never clear.

The transmission of the Fore behavioral patterns to the young began in early infancy during a period of unceasing human physical contact. The effect of being constantly "in touch" with hamlet mates and their daily life seemed to start a process which proceeded by degrees: close rapport, involvement in regular activity, ability to handle seemingly dangerous implements safely, and responsible freedom to pursue individual interests at will without danger.

While very young, infants remained in almost continuous bodily contact with their mother, her house mates or her gardening associates. At first, mothers' laps were the center of activity, and infants occupied themselves there by nursing, sleeping and playing with their own bodies or those of their caretakers. They were not put aside for the sake of other activities, as when food was being prepared or heavy loads were being carried. Remaining in close, uninterrupted physical contact with those around them, their basic needs such as rest, nourishment, stimulation and security were continuously satisfied without obstacle.

By being physically in touch from their earliest days, Fore youngsters learned to communicate needs, desires and feelings through a body language of touch and response that developed before speech. This opened the door to a much closer rapport with those around them than otherwise would have been possible, and led ultimately to the Fore brand of social cement and the sixth sense that bound groups together through spontaneous, responsive sharing.

As the infant's awareness increased, his interests broadened to the things his mother and other caretakers did and to the objects and materials they used. Then these youngsters began crawling out to explore things that attracted their attention. By the time they were toddling, their interests continually took them on short sorties to nearby objects and persons. As soon as they could walk well, the excursions extended to the entire hamlet and its gardens, and then beyond with other children. Developing without interference or supervision, this personal exploratory learning quest freely touched on whatever was around, even axes, knives, machetes, fire, and the like. When I first went to the Fore, I was aghast.

Eventually I discovered that this capability emerged naturally from the Fore infant-handling practices in their milieu of close human physical proximity and tactile interaction. Because touch and bodily contact lend themselves naturally to satisfying the basic needs of young children, an early kind of communicative experience fostered cooperative interaction between infants and their caretakers, also kinesthetic contact with the activities at hand. This made it easy for them

Learning to be a toddler, a Fore baby takes its first experimental steps. No one urges him on.

Dr. Sorenson, director of the Smithsonian's National Anthropological Film Center, wrote The Edge of the Forest *on his Fore studies.*

to learn the appropriate handling of the tools of life.

The early pattern of exploratory activity included frequent return to one of the "mothers." Serving as home base, the bastion of security, a woman might occasionally give the youngster a nod of encouragement, if he glanced in her direction with uncertainty. Yet rarely did the women attempt to control or direct, nor did they participate in the child's quests or jaunts.

As a result Fore children did not have to adjust to rule and schedule in order to find their place in life. They could pursue their interests and whims wherever they might lead and still be part of a richly responsive world of human touch which constantly provided sustenance, comfort, diversion and security.

Learning proceeded during the course of pursuing interests and exploring. Constantly "in touch" with people who were busy with daily activities, the Fore young quickly learned the skills of life from example. Muscle tone, movement and mood were components of this learning process; formal lessons and commands were not. Kinesthetic skills developed so quickly that infants were able to casually handle knives and similar objects before they could walk.

Even after several visits I continued to be surprised that the unsupervised Fore toddlers did not recklessly thrust themselves into unappreciated dangers, the way our own children tend to do. But then, why should they? From their earliest days, they enjoyed a benevolent sanctuary from which the world could be confidently viewed, tested and appreciated. This sanctuary remained ever available, but did not demand, restrain or impose. One could go and come at will.

In close harmony with their source of life, the Fore young were able confidently, not furtively, to extend their inquiry. They could widen their understanding as they chose. There was no need to play tricks or deceive in order to pursue life.

Emerging from this early childhood was a freely ranging young child rather in tune with his older and younger hamlet mates, disinclined to act out impulsively, and with a capable appreciation of the properties of potentially dangerous objects. Such children could be permitted to move out on their own, unsupervised and unrestricted. They were safe.

Such a pattern could persist indefinitely, re-creating itself in each new generation. However, hidden within the receptive character it produced was an Achilles heel: it also permitted adoption of new practices, including child-handling practices, which did *not* act to

In infancy, Fore children begin experimental play with knives and other lethal objects. Sorenson never saw a child warned away or injured by them.

perpetuate the pattern. In only one generation after Western contact, the cycle of Fore life was broken.

Attuned as they were to individual pursuit of economic and social good, it did not take the Fore long to recognize the value of the new materials, practices and ideas that began to flow in. Indeed, change began almost immediately with efforts to obtain steel axes, salt, medicine and cloth. The Fore were quick to shed indigenous practices in favor of the Western example. They rapidly altered their ways to adapt to Western law, government, religion, materials and trade.

Sometimes change was so rapid that many people seemed to be afflicted by a kind of cultural shock. An anomie, even cultural amnesia, seemed to pervade some hamlets for a time. There were individuals who

Babies have free access to the breast and later, like this toddler being helped to kernels of corn by an older girl, can help themselves to whatever food is around—indulged by children and grown-ups.

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On the way to hunt birds, cuscus (a marsupial) or rats, Fore boys stride through a sweet-potato garden.

A girl goes over a garden stile. Gardens are fenced to keep pigs out of the hamlet's plantings.

appeared temporarily to have lost memory of recent past events. Some Fore even forgot what type and style of traditional garments they had worn only a few years earlier, or that they had used stone axes and had eaten their dead close relatives.

Remarkably open-minded, the Fore so readily accepted reformulation of identity and practice that suggestion or example by the new government officers, missionaries and scientists could alter tribal affiliation, place names, conduct and hamlet style. When the first Australian patrol officer began to map the region in 1957, an error in communication led him to refer to these people as the "Fore." Actually they had had no name for themselves and the word, Fore, was their name for a quite different group, the Awa, who spoke another language and lived in another valley. They did not correct the patrol officer but adopted his usage. They all now refer to themselves as the Fore. Regional and even personal names changed just as readily.

More than anything else, it was the completion of a steep, rough, always muddy Jeep road into the Fore lands that undermined the traditional life. Almost overnight their isolated region was opened. Hamlets began to move down from their ridgetop sites in order to be nearer the road, consolidating with others.

The power of the road is hard to overestimate. It was a great artery where only restricted capillaries had existed before. And down this artery came a flood of new goods, new ideas and new people. This new road, often impassable even with four-wheel-drive vehicles, was perhaps the single most dramatic stroke wrought by the government. It was to the Fore an opening to a new world. As they began to use the road, they started to shed traditions evolved in the protective insularity of their mountain fastness, to adopt in their stead an emerging market culture.

The coming of the coffee economy

"Walkabout," nonexistent as an institution before contact, quickly became an accepted way of life. Fore boys began to roam hundreds of miles from their homeland in the quest for new experience, trade goods, jobs and money. Like the classic practice of the Australian aborigine, this "walkabout" took one away from his home for periods of varying length. But unlike the Australian practice, it usually took the boys to jobs and schools rather than to a solitary life in traditional lands. Obviously it sprang from the earlier pattern of individual freedom to pursue personal interests and opportunity wherever it might lead. It was a new expression of the old Fore exploratory pattern.

Some boys did not roam far, whereas others found ways to go to distant cities. The roaming boys often sought places where they might be welcomed as visi-

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tors, workers or students for a while. Mission stations and schools, plantation work camps, and the servants' quarters of the European population became way-stations in the lives of the modernizing Fore boys.

Some took jobs on coffee plantations. Impressed by the care and attention lavished on coffee by European planters and by the money they saw paid to coffee growers, these young Fore workers returned home with coffee beans to plant.

Coffee grew well on the Fore hillsides, and in the mid-1960s, when the first sizable crop matured, Fore who previously had felt lucky to earn a few dollars found themselves able to earn a few hundred dollars. A rush to coffee ensued, and when the new gardens became productive a few years later, the Fore income from coffee jumped to a quarter of a million dollars a year. The coffee revolution was established.

At first the coffee was carried on the backs of its growers (sometimes for several days) over steep, rough mountain trails to a place where it could be sold to a buyer with a Jeep. However, as more and more coffee was produced, the villagers began to turn their efforts to planning and constructing roads in association with neighboring villages. The newly built roads, in turn, stimulated further economic development and the opening of new trade stores throughout the region.

Following European example, the segregated collective men's and women's houses were abandoned. Family houses were adopted. This changed the social and territorial arena for all the young children, who hitherto had been accustomed to living equally with many members of their hamlet. It gave them a narrower place to belong, and it made them more distinctly someone's children. Uncomfortable in the family houses, boys who had grown up in a freer territory began to gather in "boys' houses," away from the adult men who were now beginning to live in family houses with their wives. Mothers began to wear blouses, altering the early freer access to the breast. Episodes of infant and child frustration, not seen in traditional Fore hamlets, began to take place along with repeated incidents of anger, withdrawal, aggressiveness and stinginess.

So Western technology worked its magic on the Fore, its powerful materials and practices quickly shattering their isolated autonomy and life-style. It took only a few years from the time Western intruders built their first grass-thatched patrol station before the Fore way of life they found was gone.

Fortunately, enough of the Fore traditional ways were systematically documented on film to reveal how unique a flower of human creation they were. Like nothing else, film made it possible to see the behavioral patterns of this way of life. The visual record, once made, captured data which was unnoticed and unanticipated at the time of filming and which was simply impossible to study without such records. Difficult-to-spot subtle patterns and fleeting nuances of manner, mood and human relations emerged by use of repeated reexamination of related incidents, sometimes by slow motion and stopped frame. Eventually the characteristic behavioral patterns of Fore life became clear, and an important aspect of human adaptive creation was revealed.

The Fore way of life was only one of the many natural experiments in living that have come into being through thousands of years of independent development in the world. The Fore way is now gone; those which remain are threatened. Under the impact of modern technology and commerce, the entire world is now rapidly becoming one system. By the year 2000 all the independent natural experiments that have come into being during the world's history will be merging into a single world system.

One of the great tragedies of our modern time may be that most of these independent experiments in living are disappearing before we can discover the implications of their special expressions of human possibility. Ironically, the same technology responsible for the worldwide cultural convergence has also provided the means by which we may capture detailed visual records of the yet remaining independent cultures. The question is whether we will be able to seize this never-to-be repeated opportunity. Soon it will be too late. Yet, obviously, increasing our understanding of the behavioral repertoire of humankind would strengthen our ability to improve life in the world.

Any child and any adult, related or not, may get along in a Fore hamlet. The secret: interaction—and trust.

By Lee M. Talbot

Wildlife quotas sometimes ignored the real world

Biologists long ago adopted the concept of maximum sustainable yield to set harvests, but it is at best only a rule of thumb

Elephants at Tsavo East National Park in Kenya are obviously disrupting their environment.

For years a widely accepted "law of nature" has maintained that a certain number of a given animal population can be killed for sport or profit each year without affecting its stability. This percentage of wildlife and fish allotted to the harvester is called the maximum sustainable yield (MSY).

To illustrate this MSY theory, let us say there are 1,000 deer living in a woods. Because they are at the limit of that area's capacity to support deer, their birthrate is low, and each year the relatively few births equal the number of deer that die of natural causes. There is no "surplus" that hunters can take and still leave the population stable at 1,000. If the population were reduced to about 600, however, each deer would be in better condition and birthrates would increase, because now only 600 deer would be sharing the food and other resources which formerly supported 1,000. There should be about 300 more births than deaths, and if hunters shoot 300 deer each year, the population should remain stable at 600. The MSY for deer in that woods would be 300.

This MSY concept is exquisite in its simplicity and, in one form or another, it has been basic to management—where management has occurred—of sport and commercial harvesting of fish and wildlife in much of the world. To many, the idea of maximum sustainable yield is virtually sacred. It is not simply the basis of management, it is the goal. Whales, for example, are considered wasted if the MSY is not taken in a given area. Only recently a former chairman of the International Whaling Commission spoke of whales being "left in the sea to rot" if the MSY total were not caught. This is a long way from the original conservation use of MSY, in which it was intended that the MSY for each species should serve as the outer limit, not a goal at which to aim.

While I was disturbed by the changing application of the MSY principle, for some years I did not question the basic theory. Then, in 1959, in the course of an ecological study of the Serengeti-Mara region of East Africa, my wife and I tried to apply the MSY concept to wildebeests. After collecting data and analyzing it, we came to the conclusion that in real life MSY does not work

The goal of maximizing benefits on a sustained basis is great. Less great, indeed unworkable, is the simplistic application of that goal to a single species in isolation from the ecological facts of life.

To begin with, MSY assumes a stable population and that the number of animals a habitat can support is fixed. But in fact such stability is rare. During the time we followed the wildebeests, their population fluctuated from about 250,000 to more than one mil-

But removal of elephants, or any animal, from an environment can change it for all other animals.

lion, so how could you accurately estimate a maximum sustainable yield? One year's MSY might be the total number of wildebeests that the area could support in a succeeding year.

Apart from the problem of population fluctuation, MSY totally ignores the impact of hunting on the social and behavioral patterns of the animals, with potential changes in habits, especially breeding. In Kenya during the early 1900s, lions, buffalo and certain types of antelope became largely nocturnal and confined themselves to wooded areas, whereas they previously had roamed the open plains in daylight. Also, hunting during the breeding period may disrupt a complex harem structure, such as those of some antelope and wild sheep, critical to successful breeding.

Another problem that can disturb the reproduction process is either random harvest or the selective killing of the larger and, therefore, bolder animals in a population. Such killing leaves a higher proportion of younger and nonbreeding animals; in groups where several years are needed to reach sexual maturity (lobsters, many fish and most larger mammals), hunting may greatly reduce the reproductive potential.

Disruption of the social structure of other animals, from rats and mice to birds and elephants—especially when the stronger, older and more experienced members are killed—not only affects reproduction but threatens the survival of the others. With the loss of group leaders experienced in migration and in searching for food, the other animals have less chance of staying alive. While feeding and migration are instinctive in some species, they have to be learned by others.

Perhaps the most important weaknesses of the MSY concept, however, are those involving the relationships between wildlife and its environment. One fallacy of the MSY approach is that it assumes that the density of a group of animals is the only factor determining how many of them a given habitat can support. I found that, in reality, the carrying capacity is affected by many factors, including food, water, space, competition and predators. These are affected by climate, pollution, land use and other human activities.

Pribilof fur seals may be cited as an example of how factors beyond the numbers harvested affect the ability of an area to support that species. The fur seals have been managed for decades, to the point where they have been nursed back from near extinction to a population that has provided hunters with tens or hundreds of thousands of seals each year. This was considered for many years to be the prime example of the success of the single-species concept of management. In recent years, however, the harvestable population has been dropping, and it is clear the theory is not working in practice. One reason may be that the seals are now being forced to compete for fish with Japanese and, perhaps, Soviet trawlers. Another factor that may be slowing the seals' reproduction rate and inhibiting the habitat's ability to support more of the species is pollution. High levels of polychlorinated biphenyls (PCB) found in their tissues have been linked to reproduction problems among other seals and otters off the West Coast of the United States.

Another serious flaw in the MSY concept is that it assumes that if a group of animals is reduced by Man, the group will automatically come back. Some species have recovered; others have not. The American bison, wild turkey, Pribilof fur seals and gray whales have made comebacks. On the other hand, the sardines that once filled the factories on Cannery Row never did.

MSY also overlooks the critical relationship between predator and prey. In the Serengeti there are about a dozen species of predators, and any significant reduction in their prey clearly would affect the predators. Further, human predation—other than intended har-

Lee M. Talbot, a member of the Council on Environmental Quality in Washington, also has served on International Whaling Commission.

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vest—also seriously affects a species. The halibut fishery in the northeastern Pacific, off Canada and the United States, has been managed by a commission since 1953, using the MSY concept, and this had been regarded as another example of successful application. Then catches began declining dramatically. While the causes are not fully understood, it is thought that foreign trawlers have been making incidental catches of young halibut while fishing for other species.

One of the more subtle factors overlooked by MSY is the impact of harvesting on symbiotic or commensal relationships. In dry periods, the water holes dug by elephants also provide water for smaller creatures, and actually enable them to survive prolonged droughts. Any significant amount of elephant harvesting, therefore, would affect a wide variety of other mammals as well as some birds and reptiles. Large alligators in the southeastern United States also dig holes, which provide water in dry months for many other species.

The more I tried to apply MSY calculations to the wildebeests in the Serengeti, the more reasons I found why maximum sustainable yield just would not work for the wildebeest. It became clear to me that management could not simply deal with a single species in isolation from its environment. MSY, it seemed, was one of those handy approximations of the real world that originally were never intended to be applied outside the classroom. Once accepted, however, the theory was never questioned or adequately tested in the field. Set in the concrete of school curricula and national or international legislation, MSY turned into a goal and became the sole basis of determining how many animals of a species could be killed.

While MSY was being canonized, the exploitation of fish and wildlife continued to increase. Between 1950 and 1970 the world's total fin-fish catch increased from 21 million tons to 70 million. More nations and more ships were involved, and more efficient ships, better nets and catching techniques and, with sonar and airplanes, better locating methods all increased the catch. Thus, the potential for overfishing was increased immeasurably, while the problems of controlling catches grew more and more complicated. Where one or two nations might have been involved in fishing one kind of fish 20 or 30 years before, 15 to 20 might now be involved.

Our African research was followed by advisory or consulting positions involving resource management over much of the world. We found that virtually always the focus of national and international development efforts was on increasing the harvest of a given species, in isolation from the ecosystem, and with no effective concern for the long-term welfare of the resource. The living resources of the world's oceans were being particularly hard hit, and it appeared to me that a fundamental change was required.

Positions with the Smithsonian Institution and the Council on Environmental Quality provided opportunities to work with the International Whaling Commission. From the start it was clear that the scientific basis for managing whales was grossly inadequate, in terms of both basic

Seals are herded to harvest in Pribilof Islands. Here a quota system had been working well until recently.

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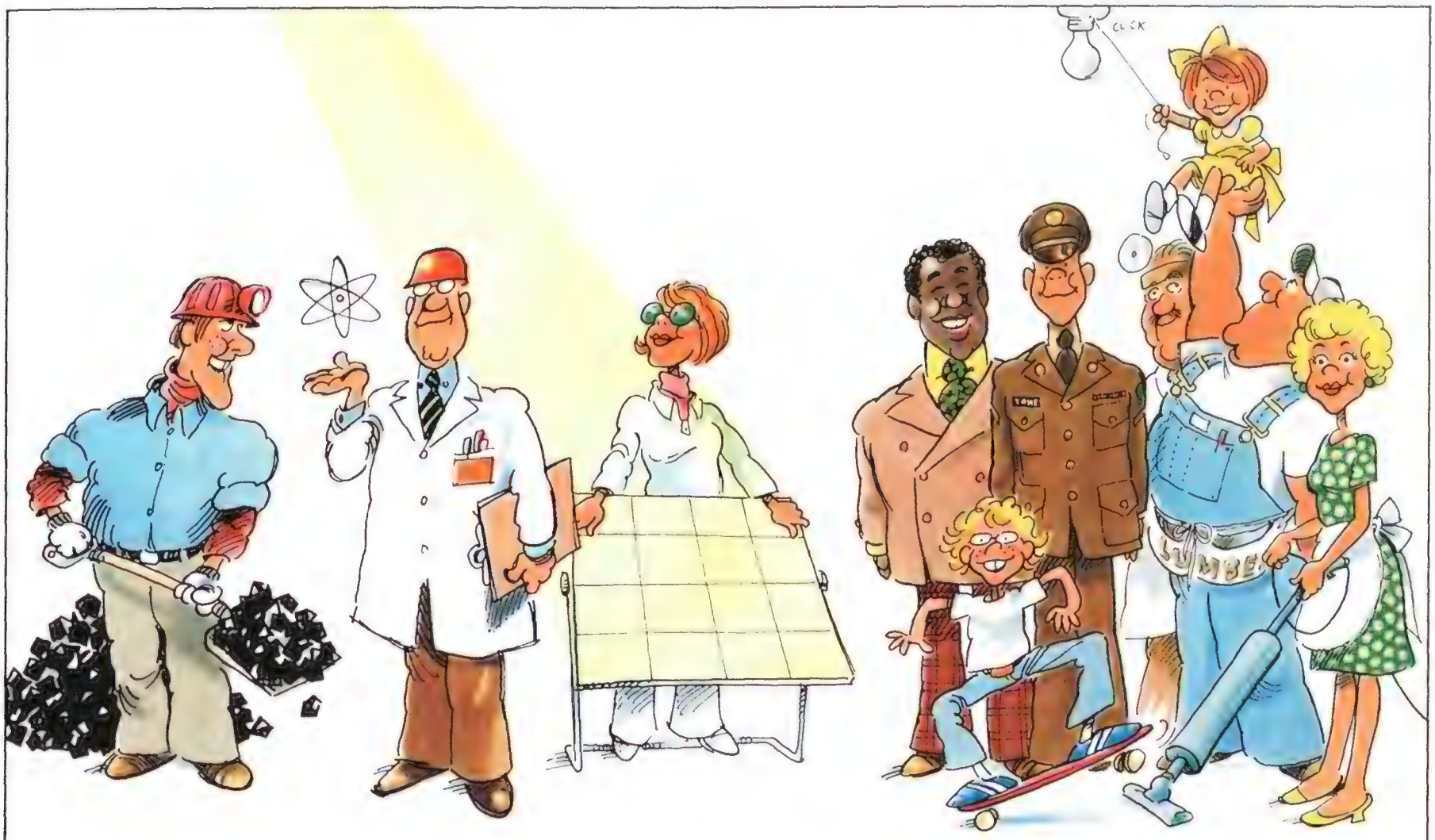

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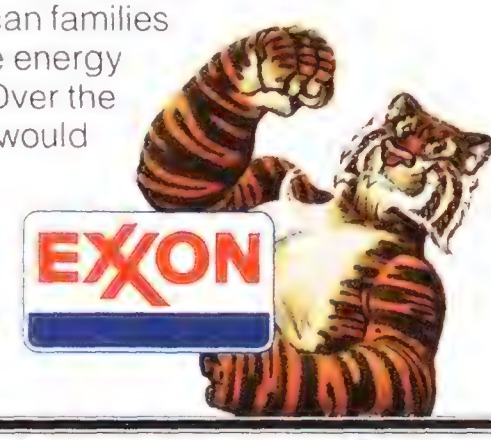
And that's a lot of energy for a strong America.



Energy for a strong America

data and scientific concepts. I well remember the scene when in 1972 I proposed to the Scientific Advisory Committee of the IWC that instead of focusing totally on MSY as our measuring stick, we should consider an ecologically optimum yield—taking the ecological relationships into account—when developing harvest guidelines. The suggestion was greeted by amazement, bafflement, or outright scorn by committee members—with one notable exception: Professor Douglas Chapman of the University of Washington.

"That's a very interesting concept," he observed, after hearing my presentation. I thought he was merely being polite, but he later wrote a thoughtful paper urging the commission to adopt the concept of optimum yield as opposed to maximum yield. By 1974, on the recommendation of its scientific advisory committee, the IWC agreed that the management of whales "should be based not only on the concept of sustainable yield in numbers by species, but should also include considerations such as total weight of whales and interactions within the marine ecosystem." Last year the whaling commission passed another resolution, this one stating that whale stock should never be taken at more than 90 percent of the MSY.

Congress was persuaded to include in the Marine Mammal Protection Act the statement that "the primary objective of management [of marine animals] should be to maintain the health and stability of the marine ecosystem." Further, that harvesting may be conducted only when it is consistent with the primary objective, keeping in mind the optimal carrying capacity of the habitat.

It was clear at the time that we did not have adequate ecological knowledge to manage for the health and stability of the ecosystem. But I believed that writing this objective into law would force change to a more ecologically sound management objective, as well as force research to obtain the data needed for that management. It has served to do both, but the information has come slowly and there is much resistance to changing old ways. Because of this there are current efforts to drop the ecological wording from the

A harvest of one species on this African plain will affect all the other species.

Act instead of following the responsible —but bureaucratically more difficult— course of accelerating the necessary ecological research and management efforts.

While the ecological orientation of the Marine Mammal Protection Act and the progress in the IWC represented significant steps in the right direction, I was still seriously concerned about losing ground elsewhere. In particular, it ap-

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peared that there was real danger of worldwide adherence to MSY in the development of the Law of the Sea. The original approach of the United States and some other developed nations was that the world's fish stocks should be "fully utilized" according to the principle of maximum sustainable yield. If this approach were frozen into international law, it would be literally legislating overfishing. In tiresome discussions with policy-makers, all I heard was the same old litany: "MSY is basic to international law. . . . It's simple, understandable and the biologists support it."

Given this situation, it seemed to me that the best approach would be to bring key biologists and policy makers together in a workshop situation. Helping to organize the program were Thomas Lovejoy of the U.S. Appeal of the World Wildlife Fund, which financed the program; Richard Miller, then president of the Ecological Society of America; and S. Dillon Ripley and David Challinor of the Smithsonian Institution. These three organizations, plus the Council on Environmental Quality and the International Union for the Conservation of Nature and Natural Resources, joined to form a broad sponsorship for two workshops.

Among the fields represented were ecology, animal biology, animal statistics, fishery science, wildlife management, resource economics, law and public administration. As I had expected, they were hot sessions, but when the smoke cleared, to my delight the workshop participants agreed that simplistic concepts like MSY were not adequate to manage effectively the world's wild living resources.

Colin Clark, a mathematician from the University of British Columbia who has made a major impact on resource economics, probably provided the most telling nonbiological argument against the status quo in wildlife management. He contended that where there is competition among fishermen, the inevitable result is overfishing to the point of diminishing returns, and that to reestablish MSY at that point requires significant sacrifices by the fishermen. Clark branded as fallacious an old theory that says diminishing returns will cause Man to stop overfishing before a species is forced into extinction. The truth is, he said, that there is a point where pursuing a species virtually to extinction is by far the most economically profitable course to follow. He cited the exploitation of the world's whales, where one stock after another has been harvested until all eight of the world's great whales are now endangered.

The workshop, in developing a set of recommendations, recognized that wild-

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life management concepts simply have not kept up with changes in conditions of resources, the nature and magnitude of animal exploitation, and the development of scientific knowledge. The group agreed on four basic principles.

The first principle recognizes the need to deal with the ecosystem as a whole, rather than to try to manage a single species in isolation. We must avoid irreversible loss, such as extermination of a species, or long-term adverse impacts, such as the gross depletion of most great whales. We must maintain our options for further uses of species, recognizing that our views regarding the value of a species may change over time. For example, species now regarded as "trash fish" may become important in the future.

Although management still focuses on values related to fishing and hunting, there is an increasing recognition of the importance of other considerations when dealing with wildlife. One is the role of the species in maintaining the health and stability of the ecosystem of which it is a part. Another is the role of wildlife in giving enjoyment to those who admire, study or photograph.

The other principles stated that:

Any management decision should include a margin of safety to allow for the limited knowledge of ecosystems and imperfect management.

Measures to conserve one living resource should be developed and applied to avoid wasteful use of other resources.

Surveys or ecological studies should precede new or changed uses of resources, and adequate monitoring and analysis must accompany the actual use of the resources, with results available promptly for critical public review.

The principal of applying safeguards may sound reasonably clearcut at first

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glance, but it is complicated. Management of deer hunting in North America, for instance, involves a high degree of control over the hunters, the areas where the deer are hunted, and the state of the rest of the habitat. Here, the impact of the hunting can be seen and monitored directly. In contrast, ships of 20 nations, not all adhering to a management program, may be catching a species of fish on the open seas. Little would be known about ecology or numbers of the species, the state of the habitat, or even the size of the catch. In this case the margin of safety must be far greater than in the case of deer hunting.

Overall, the principles redefine the primary goal of wildlife management as the management of the habitat so that resources may be enjoyed today without being used up before future generations have the same opportunity. Most of the principles are explicitly stated in the Fishery Conservation and Management Act of 1976, which extended our jurisdiction over fisheries to 200 miles off our coasts. The Act specifies "optimum yield" rather than MSY. It also requires that new fishery agreements be negotiated with any nation which wishes to fish within our 200-mile zone, and the ten agreements negotiated so far all specify "optimum yield."

MSY has been changed to optimum yield in the revised negotiating text for the Law of the Sea. The International Union for Conservation of Nature and Natural Resources has accepted the workshops' results in full and has recommended that they be adopted by its membership, which represent more than 100 nations. The recommendations are finding use worldwide, from the fisheries activities of the United Nations Food and Agriculture Organization to the current problem of incidental kill of porpoises by tuna fishermen.

But while we have had an impact on policy as well as scientific thought and management, it must be clearly understood that this is merely the beginning. There is much resistance to changing old and established ways. And in most cases, we simply do not yet have the ecological information necessary to apply a truly ecological approach.

Consequently we are faced with the need to obtain the necessary information, and the need to persuade those responsible for our living resources to apply the information and the new principles. These are the challenges which we still face if we are to obtain truly effective management of our living resources and the ecosystems on which they—and we—all depend.

A nine-month-old white-tailed deer, weakened by starvation, could be considered the victim of a harvest that was too small rather than too large.

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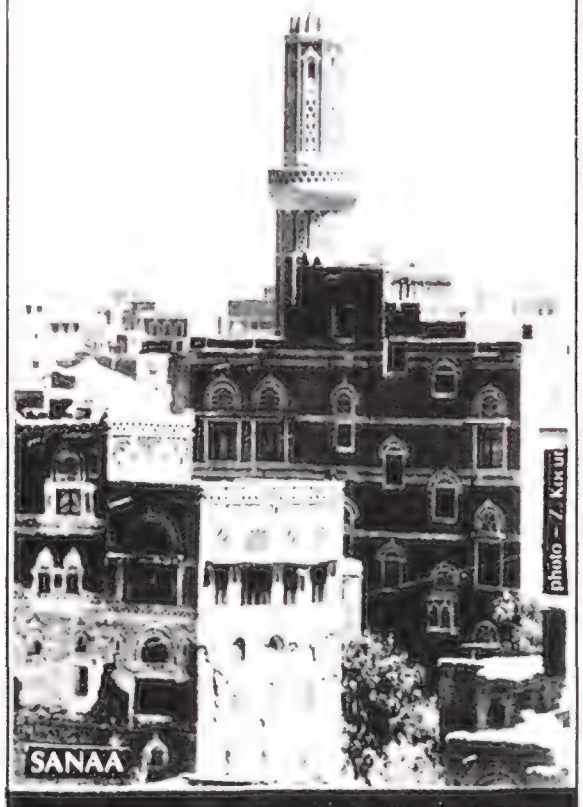

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A Biography of Charles Grafton Page
Robert Charles Post
(Science History Publications, $15.95)

I received this book with some degree of puzzlement, never having heard of Charles Grafton Page, but recalling and drawing encouragement from the fact that the last physicist who worked in a patent office, Albert Einstein, didn't turn out too badly. Indeed, Page's contributions, if not as revolutionary as the theory of relativity, were substantial, and made him as famous, in the mid-19th century, as his friend and fellow physicist, the great Joseph Henry.

Page's most notable achievements were his experiments that extended significantly the work of Faraday and Henry on electromagnetic induction. His "Magneto-Electric Multiplier" was, in essence, the first closed-core transformer ever built, possessing elements of an electromagnet, induction coil and motor-generator. The so-called Ruhmkorff coil, an induction coil which became a staple of all physics laboratories in the 1860s, had its origin in Page's lab in 1838 when he was 26, some 12 years before Ruhmkorff built his first model in France. Page's speculation on "closed secondary currents" in the winding and core of a magnet anticipated, with Henry, the phenomenology of hysteresis—residual magnetism remaining after magnetizing current is zero.

One of Page's potentially most useful inventions was the magneto, basically a generator, which first demonstrated that electrical power could be made without recourse to chemicals. The magneto, oddly, languished until after Page's death in 1868 when abundant water power was used for the generation of electricity. This is doubly ironic when one considers Page's greatest blunder—a self-powered car ("tank" might be closer) that attempted to use chemical batteries beyond what was practical in an engineering sense, much less economical. The first test of this ponderous vehicle looked like a scene from a Marx Brothers movie—acrid smoke poured from cracked battery cells, acid ruined the clothing of its astonished passengers, who fled, along with a complement of bolting horses, crying children and barking dogs.

Given Page's accomplishments, why has he become an unknown, even within scientific circles? The answer, though enigmatic, probably begins with Page's equally enigmatic move from Boston to Washington, D.C., in 1838. In 1842 he took a job as an examiner in the Patent Office, a politically vulnerable department, often subject to Congressional meddling and rife with privilege-seekers continually currying favor with officials. Page not only hung out with these Patent Office groupies, but on occasion used his position in an ethically questionable way, perhaps the most blatant example being his advisory position to Samuel F. B. Morse—he kept Morse aware of potential competitors' patents—while apparently holding substantial financial interest in Morse's telegraph company.

In his waning years, Page seemed taken by a strong urge to recapture his prior

Among the Newhaven portraits:

fame as an inventor-scientist. This led him to claim credit for important contributions in the development of telegraphy; and, though doubtless true, it was done in a manner that completely alienated Morse, who had been his friend for 20 years. In a final burst of indiscretion, Page used personal influence to obtain a patent by special Act of Congress, this being normally proscribed to Patent Office employees.

Post's descriptions of apparatus will make substantial demands on lay readers, but his book does much to restore the scientific reputation of a man whose achievements warrant more than his present consignment to limbo. One can only speculate what Page might have done further had he stayed with electromagnetism. Einstein, fortunately, had the good sense to leave the Swiss patent office.
—Dale F. Dickinson
Smithsonian Astrophysical Observatory

An Early Victorian Album: The photographic masterpieces (1843-1847) of David Octavius Hill and Robert Adamson
Edited and introduced by Colin Ford, with an interpretive essay by Roy Strong
(Alfred A. Knopf, $35)

The flowering of British photography in the second half of the 19th century has only begun to be fully explored. By now, Julia Margaret Cameron and Peter Henry Emerson are familiar names to photography aficionados, but such important predecessors as David Octavius Hill

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and Robert Adamson have just recently come to the public's attention.

The pictures of Hill and Adamson are calotypes, images made by a technical process that is the true basis for the modern photographic method. The earliest images to be fixed on a plate were called daguerreotypes, but it is the calotype (from the Greek "kalos" for beautiful) that overcame many of the limitations of this earlier procedure. In a daguerreotype, exposure time was lengthy and the picture produced was a unique image, one that could not be duplicated. The calotype shortened exposure time considerably and yielded a paper negative that could be used to produce multiples of the same image.

As historical circumstance would have it, the calotype first received extensive study in Scotland. There it was introduced to the young Robert Adamson, who brought to photography a broad scientific background that ranged from an interest in steam engines and boats to the mechanics of wheelbarrows.

To his technical expertise was wed the esthetic interests of David Octavius (so named to signify his position as the eighth child in his family) Hill. Trained in painting and lithography, Hill spent most of his life as a painter of romantic landscapes. His interest in photography began with a specific problem.

On May 18, 1843, Hill witnessed the resignation of 155 ministers from the Church of Scotland, a protest occasioned by the interference of the Crown and wealthy landowners in the Church's activities. The number of dissident clergymen grew to nearly 500, and this "Disruption," as the protest was called, resulted in the founding of the Free Church of Scotland.

To record this event, Hill decided to create a monumental painting. His major problem was the documentation of the almost 500 faces that were to be included in the work. At this point, the use of the new calotype procedure was suggested to him, and the artist was referred to Adamson for help and guidance. Despite their differences in age (Hill was senior by 19 years) and background, the collaboration proved amicable and successful. They decided not to restrict themselves to gathering reference material for the painting, and thus the partnership began.

The division of labor in this collective endeavor reflected their respective inter-

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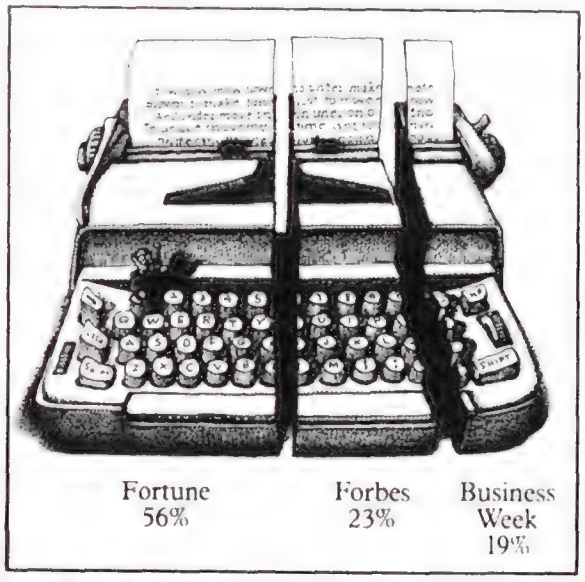

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ests. Hill arranged the settings, positioned the sitters, chose the costumes and retouched the negatives. Adamson involved himself with the technical end of the business. As might be suspected, their sitters at first consisted principally of clergymen who had taken part in the Disruption.

Family and friends soon appeared in their pictures as well, and images of sleeping children—apparently the only way to keep their diminutive sitters still during the exposure—are among the most charming examples of the partners' work. Tableaux in full costume were another popular subject, but the partners also found interest in more candid scenes, such as those of life in the fishing village of Newhaven. This last group of pictures, consisting of some 70 photographs, was originally taken for fund-raising purposes, part of an effort to replace dangerous fishing boats that were then in use.

In their four years of partnership, working with relatively primitive photographic means, Hill and Adamson produced somewhere between 1,500 and 3,000 pictures, 250 of which are illustrated excellently in this handsomely designed and produced book. The demands of his dedicated, almost obsessive work ultimately destroyed Adamson's delicate constitution. He died in 1848 at the age of 27. With his partner gone, Hill soon returned to painting full time. In 1866, he finished work on the Disruption scene. Hill dabbled in photography again after Adamson died. None of these later efforts, however, came close to equaling the landmark results of his collaboration with Robert Adamson.

—Mary Ann Tighe
Author, *Art America*

The Solar Home Book
Bruce Anderson with Michael Riordan
(Cheshire Books, $7.50)

Other Homes and Garbage
Jim Leckie, Gil Masters,
Harry Whitehouse and Lily Young
(Sierra Club Books, $9.95)

The spate of general books on renewable energy sources spawned by the oil embargo has given way to a new generation which stresses practical application. These are design books. They take the reader up to the point of installation. They cover the fundamentals: how solar technology operates; how to estimate the

size of collectors necessary for one's own situation; sizing of the storage systems; the economics of solar energy; the fundamentals of energy conservation.

These books, although popularly written, are not to be digested in one sitting. As the engineer-authors of *Other Homes and Garbage* note in their foreword, "Fantasy is fun; design is hard work. . . . Design is not fantasy alone; we must *know how* to achieve what we imagine and desire. Engineering and scientific information and tools are the means by which we change the situation we have to the one we would like to have." The reward for putting some effort into learning the design process is being able to converse knowledgeably about solar-energy systems with, at the very least, builders, architects and local sales representatives of solar companies.

There are still few books of this type in the stores. These are two of the best.

The Solar Home Book has been three years in development, and the wait has been worth it. It is the best book to date on solar energy for residential use. The easy-to-read format, illustrations and style of writing may make this book as attractive as its content. Anderson, an architect with several years' experience in solar design, emphasizes designing the building correctly in the first place by orienting it to take advantage of natural climate. But there is abundant information on the use of solar energy for existing houses.

The book briefly surveys existing solar homes, and then explores in detail the fundamentals of calculating energy flows. It covers the basics, but goes beyond the basics in several areas. Its discussion of the complicated process of estimating the angle of the sun is the most readable I have seen. It analyzes the use of windows as collectors, and also provides a method for evaluating the efficiency of collectors and of total systems, two items often overlooked by other solar writers.

Although decentralized energy systems comprise the main focus of *Other Homes and Garbage*, the four engineer-authors explore other aspects of self-sufficient living, including waste handling, water supplies and food and fish production. The book is a remarkable achievement. Using simple arithmetic and abundant illustrations, it takes the reader through the design process step by step. The fundamentals of solar technology are excellently

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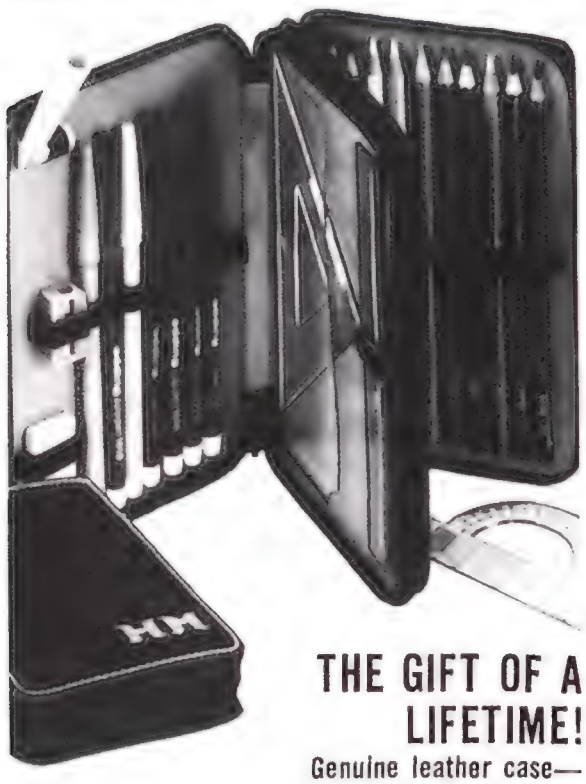

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For those who want a nuts and bolts design book on solar energy, with the added bonus of sections on other aspects of self-sufficient living, this book will be the standard text for quite some time.
—David Morris
Author of books and articles on energy

The Camera of My Family
Catherine Hanf Noren
(Alfred A. Knopf, $20)

On page nine of this family album is an oval blowup of a fat little child's hand. "Meta's plump hands are to appear again and again in this book," the caption reads. "She has 'bequeathed' them to all four of her children, and they in turn to their children."

A charming detail. There are other details. On the family charts showing various branches of the author's German Jewish ancestors, some names are starred. These were the concentration camp victims. Each family tree is sprinkled with those discreet little stars.

Family histories are made up of such details. Minutiae that never would concern the conventional historian, they are nevertheless the small human touches that can make a distant time and place come alive for us.

With some wonderful old photographs, letters and reminiscences, Mrs. Noren has produced a saga: more than a portrait of the rise, fall and resurgence of a German merchant family, more than a document on the Jewish flight from the Nazi regime, it triumphs finally as a chronicle of a family whose faces we come to know gradually, in childhood, in their prime, in old age; in a word, people we care about.

It can be a confusing book. The Adolfs and Lottes, the Ilses and Frantzes are thrown at us in great batches, from this branch and that, the men so often posing rather pompously in leather Alpine

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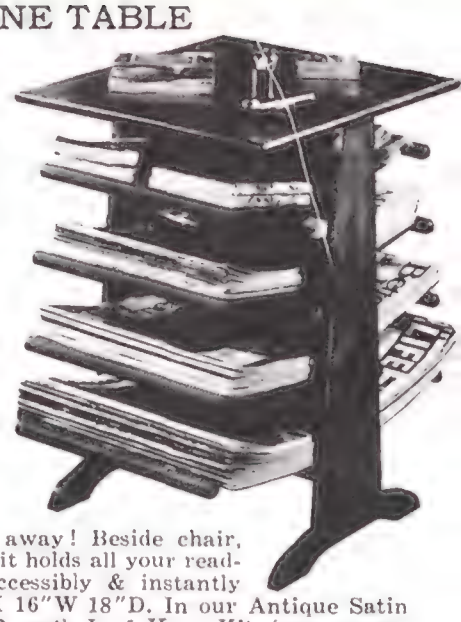

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clothing (one in a Dracula cape, broodingly Byronic atop a crag), the women in bustles and massive hats. These are by no means all formal portraits. People have been captured in the full rush of their lives: uniformed in a World War I dugout; in party costume; at the summer cottage; in the snow; at the beach; on a lake outing; cavorting in tights; clowning with unnamed friends, those jolly ghosts, those smiling strangers who appear in every family album, known only to the others in the picture, unclaimed, so far as we know, forever.

Confusing it all may be, but it is, nevertheless, a wonderful confusion, an abundance of humanity.

One of the most poignant sections tells of the efforts to escape Europe before the Holocaust. Some got out early; others waited too long, until the American immigration policy of the day plus Nazi bureaucracy and increasing intransigence left them trapped inside Germany. There are letters from relatives in Germany, the first ones busily discussing luggage and visas, the last merely saying goodbye and sending love to the ones who made it.

Through the 100 years covered by the book, we see great changes in clothes, in buildings, in the decor of rooms, in the look of cities. One could almost judge a family album by the things going on around the edges of the pictures, the car in the driveway, the paintings on the walls, all the little clues to who these people really were and how they related to their world. *The Camera of My Family* has some marvelous stuff. Three wedding photographs, for instance, in 1908, 1943 and 1970, are a study in themselves for differences in locale, clothes, stance and attitude, from the earliest couple's agony of self-consciousness to the latest couple's high-voltage kiss.

Also interesting to note is how the modern generations have scattered, to Israel and Australia and all over America, venturing into a variety of life-styles (one makes silver hashpipes in Berkeley) that no doubt would have left those polite inhabitants of the early pages popeyed with astonishment. Yet not, one suspects, with disapproval.

A strong book, intelligent and infinitely touching. A book the reader will keep leafing back through. A teeming book, loud with many voices.

—*Michael Kernan*
Staff writer, *The Washington Post*

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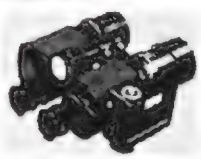

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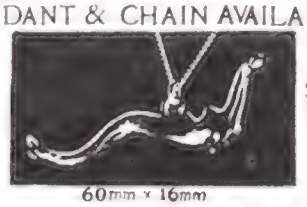
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Additional reading

Space shuttle (p. 38)

Carrying the Fire by Michael Collins, Farrar, Straus & Giroux, Inc., 1974

"Space Shuttle," NASA Publication SP-407, U.S. Government Printing Office, 1976

"Skylab, A Guidebook" by Leland F. Bellew and Ernst Stuhlinger, U.S. Government Printing Office, 1973

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"New Horizons," NASA Publication EP-117, U.S. Government Printing Office, 1975

Toxic plants (p. 48)

Poisonous Plants of the United States and Canada by John M. Kingsbury, Prentice-Hall, Inc., 1964

Human Poisoning from Native and Cultivated Plants by James W. Hardin and Jay M. Arena, M.D., Duke University Press, 1969

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California art (p. 56)

A Period of Exploration, San Francisco 1945-1950 by Mary Fuller McChesney, The Oakland Museum, 1973

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The American Campaigns of Rocham-

beau's Army 1780, 1781, 1782, 1783 (two volumes), translated and edited by Howard C. Rice jr. and Anne S. K. Brown, copublished by Princeton University Press and Brown University Press, 1972

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Chinese scrolls (p. 94)

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Maximum Sustainable Yield (p. 116)

Environmental Conservation by Raymond F. Dasmann, John Wiley & Sons, Inc., 1972

Wildlife Biology by Raymond F. Dasmann, John Wiley & Sons, Inc., 1964

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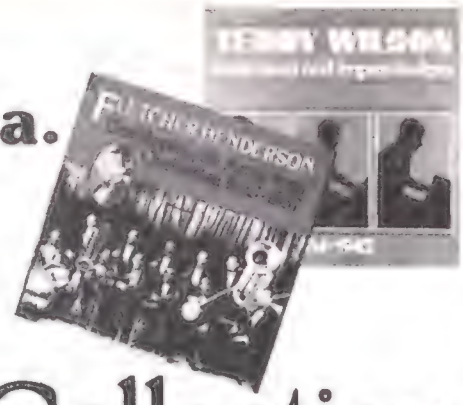

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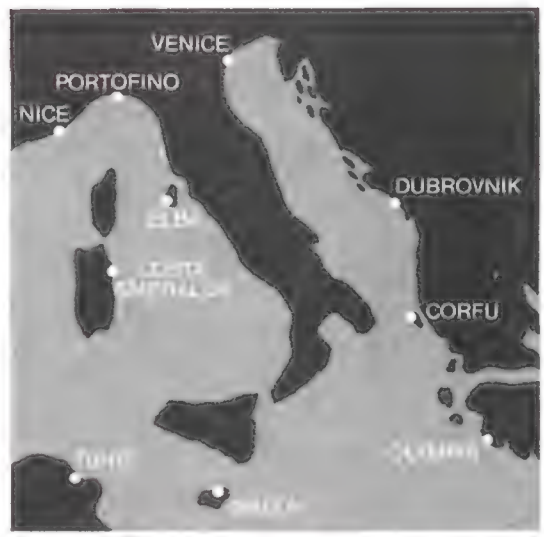

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Smithsonian highlights

Museum of History and Technology
"Celebrating a Century," an award-winning half-hour film based on preparation of the 1876 Exposition in Philadelphia, and produced by the Smithsonian, will be telecast on the PBS network May 11 and repeated May 15. Check local listings for program times. The film also is being shown Mondays, Wednesdays and Thursdays at 11:30 A.M. at the museum.

Air and Space Museum
An exhibit commemorating the 50th anniversary of Charles A. Lindbergh's solo nonstop transatlantic flight from New York to Paris (May 20-21, 1927) in the *Spirit of St. Louis* opens May 20. Photographs and films of Lindbergh's takeoff, landing and welcome on his return to the United States are featured. Also flight clothing and artifacts relating to his December 1927 goodwill flight to Central and South America.

In connection with this exhibit, a free two-hour symposium, "Charles A. Lindbergh: An American Life," is scheduled for May 20, 8 P.M., NASM Theater. Seating for 450, first come, first served. NASM Director Michael Collins will introduce the speakers: John Grierson, British Lindbergh scholar and close friend, on "The Flight"; Paul R. Ignatius, Air Transport Association of America, on "Charles Lindbergh and Air Transportation"; and Richard Hallion, NASM, on Lindbergh's role in advancing aeronautical technology. Wayne Cole, University of Maryland, and Judith Schiff, archivist of the

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The Silver Hill Museum exhibits of aircraft and objects from the NASM collections are open by advance reservation only—call (202) 381-4056 weekdays between 9 A.M. and 12 NOON.

Puppet Theater,
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"The Magic Flute," based on the libretto for Mozart's comic opera, is the spring production (through May 30) of the Nicolo Marionettes. Set in King Tut's Egypt, events center on the bird-catcher Papageno, who catches birds for the Queen but is himself caught in a search for a princess. Performances are Wednesdays through Sundays. For ticket and time information, call (202) 381-5395.

National Collection of Fine Arts
"Painting and Sculpture in California: The Modern Era" is a major exhibition (p. 56) of approximately 270 works by 199 artists, surveying painting and sculpture produced in California between 1900 and 1976. Emphasis is on those artists whose work is known nationally and internationally as well as within the state—opens May 20.

"Kaleidoscope Day, The Third Dimension," June 4, 10 AM. to 4 P.M., will be the eighth annual family day at NCFA. Participatory events for all ages are planned, with demonstrations by Washington-area artists and craftsmen. Films, dance performances, tours and treasure hunts will be directed toward children from 5 to 13.

Cooper-Hewitt Museum
The fourth annual benefit auction of donated objects will be held the evening of May 23, with a subscription preview and dance May 18 and a public preview May 18-23. Proceeds from this major fund-raising event help finance the museum's public programs. For information call the Smithsonian's National Museum of Design in New York City, (212) 860-6868.

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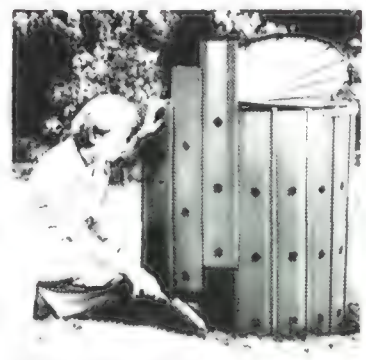

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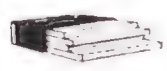

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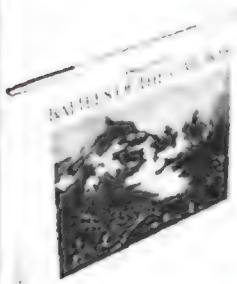

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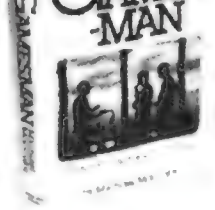

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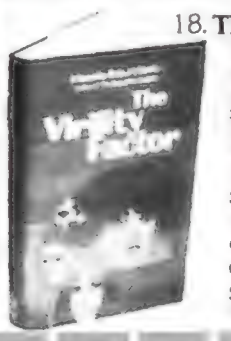

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Travel Benefits for Smithsonian Associates

With the growth of the Smithsonian Associates, the Institution is striving to meet the needs of its membership by offering a varied travel program. Traditionally, Foreign Study Tours provided culturally oriented, first-class, specialized trips under the guidance of museum curators or experts in respective fields. Then, Domestic Study Tours were added to offer similar opportunities within the United States, thus allowing Associates and their families a chance to combine vacation with a period of study. Two years ago, Foreign Charter Tours were introduced; these trips are larger, lower-cost and more generalized in nature. Associates travel benefits are announced exclusively in SMITHSONIAN. Write addresses below for additional information.

Foreign Study Tours

Russia—May 31-June 22: Emphasizing art history in Georgia and Armenia • **Baltic, Norway and the Fjords**—July 30-August 18: Cruise on the *Argonaut* to Sweden, Estonia, Russia (Leningrad), Finland; spend a week in the fjords of Norway • **The Isles of Britain**—August 19-September 3: Cruise aboard the *Argonaut* from Edinburgh at Festival time to the Orkney, Hebrides, Scilly islands, Northumbria, northern Scotland, Wales • **Peru and Ecuador**—October 4-25: Art and archaeology • Write Miss Bliss Schumann, Foreign Study Tours, SI 123, Smithsonian Institution, Washington, D.C. 20560 or call (202) 381-5520.

Foreign Charter Tours

Poland—May 12-26: An unusual and fascinating experience including the ancient Baroque city of Cracow, the magnificent tapestry collection in Wawel Castle dating from the Romanesque period, and the romantic birthplace of Chopin. Visit the enchanting fishing village where Copernicus spent 20 years of his life and produced his most important work, and make a pilgrimage to the Jasna Gora Monastery with the famous high altar of Our Lady of Czestochowa • **English Countryside Excursions***—July 25-August 8 or September 12-26: The best of London museums and theater plus a choice of specially designed four-day excursions to East Anglia and Cambridge, great houses and gardens, archaeology sites, cathedrals, literary England or Pilgrims' Way • **Paris and Provence***—September 26-October 10: Paris plus Avignon, Arles, Nîmes and Aix-en-Provence; museum seminars at the Louvre and Jeu de Paume; walking tours, excursions to the Loire, Chartres and Vaucluse • **Russia***—October 3-17: The Bolshoi, Moscow Circus, Hermitage; schools, factories and housing in Moscow, Leningrad and Tallin • **Istanbul and Asiatic Turkey***—October 10-24: An adventure tour featuring the royal treasury and collections at Topkapi Palace, the Blue Mosque, an evening in a Turkish home and a cruise on the Bosphorus. Select an excursion to Aegean Turkey including Troy and Pergamum, an important Greek and Roman city near Ephesus; or central Anatolia and Cappadocia with its exciting rugged landscape, old caravansary and the unbelievable valley of underground houses and churches that was the center of the Byzantine anchorite movement • **Mexico City and Yucatan**—November 4-15 or November 19-30: A study program in Mexico City concentrating on Aztec and Toltec cultures; visits to the Mayan ruins of Chichén-Itzá, Uxmal and Palenque (originates in Mexico City) • Low cost of tours includes first-class hotels, most meals, sightseeing, lectures, theater tickets and air fare. Foreign tours are heavily subscribed, so for additional details concerning a specific trip write early to Smithsonian Associates Travel Program, A&I 1270B, Smithsonian Institution, Washington, D.C. 20560 or call (202) 381-5635 for information. *Predeparture courses are available.

Domestic Study Tours

Chesapeake Bay Cruise—May 7-14: View the scenic and historic bay from the deck of the *Independence* cruise ship, with land excursions to Annapolis, St. Michaels, Smith Island, Williamsburg and St. Marys City • **Yosemite High Country**—June 4-13: From towering waterfalls to soaring granite spires and giant sequoias, Yosemite offers rare beauty and grandeur. Visit both the Valley and the lesser known areas of the park under the guidance of Yosemite Institute staff • **Wind River Mountains**—July 30-August 7: A horseback trip into the land of the mountain men; camping at an altitude of 10,000 feet in the midst of turquoise lakes and high-meadow wild flowers • **Desolation and Gray Canyons**—July 27-August 3 or September 30-October 10: A white-water trip for the adventurous; explore the geology, wildlife, Indian and outlaw history of Utah's Green River • **Connecticut Antiques**—August 20-27: Learn about 17th- and 18th-century architecture and decorative arts with visits to historic sites, restored homes and antique collections from New Haven to the Berkshires • **Nantucket and Newport**—September 24-October 1: Enjoy the colors of fall and the uncrowded towns on Cape Cod, Martha's Vineyard and Nantucket as well as Newport, for a look at the life and homes of the 18th and 19th centuries • **Oregon: End of the Trail**—September 10-20: Enjoy the scenic beauty of Mt. Hood, Crater Lake and the rugged coast on a nature tour of this magnificent state • **Dories on the Salmon**—September 10-25: Oar-powered wooden dories provide unique transportation through the wild, spacious, majestic country of the Salmon River in Idaho • **California Wine Country**—October 2-8: Learn about California wines with lectures and wine tastings at selected vineyards in Napa, Sonoma, Santa Clara and Monterey • **Washington "Anytime" Weekend**—Visit the nation's capital and tour the original Smithsonian building. Spend two nights at Loew's L'Enfant Plaza Hotel (reservations required ten days prior to weekend) • Write Associates Travel Program, A&I 1270B, Smithsonian Institution, Washington, D.C. 20560 for details.

The artist's personal and working life is richly documented with letters, scrapbooks, studio memorabilia, portraits of relatives and friends, and studies for major works (photographs, sculptures, oil sketches). Fifty-two paintings, including Eakins' last work, circa 1913, will be exhibited, several for the first time—opens May 24.

A free, four-hour seminar on Eakins will be held May 24 at the museum. For ticket information call (202) 381-6713.

National Portrait Gallery
More than 125 years of American portrait photography are spanned in the first exhibition prepared by the new Department of Photographs. Henry David Thoreau, Martin Van Buren, Walt Whitman and Huddie Ledbetter are among the 19th- and 20th-century notables whose likenesses appear.

"Aaron Burr Acquitted" takes a new look at Burr's treason trial, which began May 22, 1807, in Richmond, Virginia, with Chief Justice John Marshall presiding. Also depicted is Burr's post-duel, pretrial odyssey (1805-07) from Pittsburgh to New Orleans—opens May 20.

National Zoological Park
Atlas lion cubs born here during the winter are now in outdoor enclosures. Extinct in the wild, the parent lions came from the zoo in Rabat, Morocco.

"Wine and Cheese," a new self-service kiosk next to the birdhouse, offers baskets with fruit, cheese, pâté, French bread and beverages; "Panda Café," at the Panda House, features German food —10:30 A.M. to 5:30 P.M. weekends.

Divisions of Performing Arts and Musical Instruments
• The Division of Musical Instruments presents "Duo Geminiani" with Stanley Ritchie, violin, and Elizabeth Wright, harpsichord, performing works by Bach, Biber, Schmelzer, Senaillé and d'Anglebert—May 2, 8:30 P.M., Hall of Musical Instruments, History and Technology Building. The Smithsonian Chamber Players perform works by J. S. Bach, J. C. F. Bach and Handel—May 16, 8:30 P.M., Hall of Musical Instruments.
• The Jazz Heritage Series features Art Blakey, May 8, 8 P.M., Baird Auditorium,

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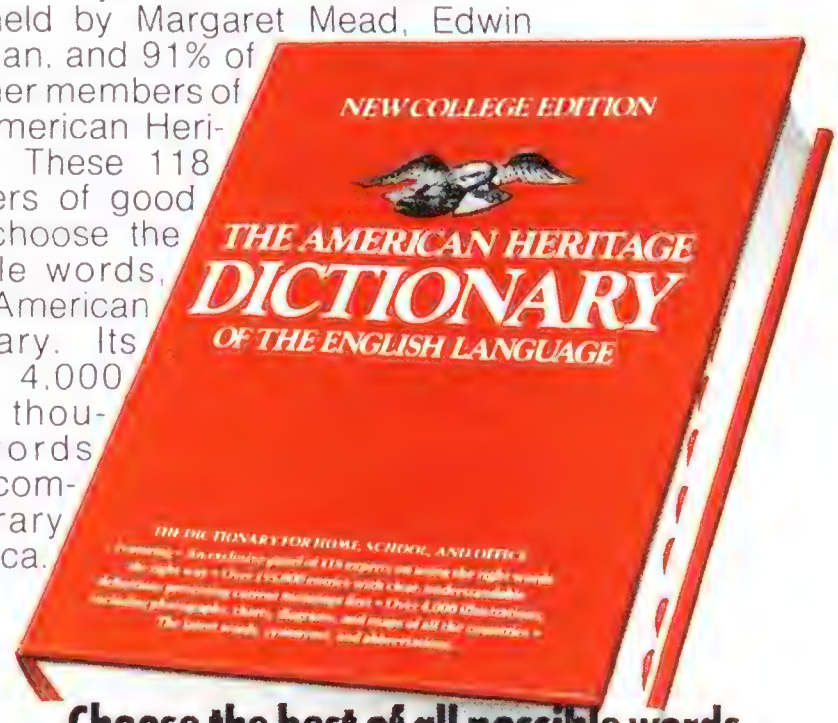

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located in the Natural History Building.

- The Theater Chamber Players play Kolb, Peter Maxwell Davies, Bach, Boccherini, and Falla—May 9, 8:30 P.M., Baird Auditorium.
- The American Popular Song Series presents Russell Nype and Lynne Stuart in a panorama of "The Great American Musical Comedy"—May 15, 8 P.M., Baird Auditorium.
- The Blues Series brings famed blues singer Joe Williams—May 30, 8 P.M., Baird Auditorium.

For ticket information call (202) 381-5395. Resident Associates, senior citizens and students may receive discounts.

Smithsonian Institution
Traveling Exhibition Service

The diversity of the Smithsonian Institution is carried to all corners of the nation by circulating shows. To find out how to bring an exhibit to your area, write: Smithsonian Institution Traveling Exhibition Service, Washington, D.C. 20560. Current SITES shows include:

- Hayward, California—"Photographing the Frontier," Chabot College Library, May 7-June 5.
- Hartford, Connecticut—"Ride On!" (bicycling's past and future), Connecticut Financial Center, May 14-June 12.
- Fort Madison, Iowa—"The Tallgrass Prairie," (Midwest land, people, heritage), Lee County Historical Center, through May 29.
- Indianapolis, Indiana—"Australia: The Fourth Part of the World," The Children's Museum—through May 28.
- Kansas City, Missouri—"Victorian Needlework," Kansas City Museum of History and Science, May 15-August 7.
- Columbus, Ohio—"Lilliput, USA, American Miniature Furnishings, 1840-1940," Columbus Gallery of Fine Art, May 14-June 12.
- Oklahoma City, Oklahoma—"The Sculpture of Jacob Epstein," The Oklahoma Museum of Art, May 7-June 5.
- Philadelphia, Pennsylvania—"Edwin Janss jr., Underwater Photography," Natural History Museum of the Academy of Natural Sciences, through May 29.

When Associates visit Washington

Upon arrival at the Smithsonian, members are invited to register at the Associates Reception Desk in the Smithsonian castle on the Mall. Here, from 10 A.M. to 4 P.M. daily, special orientation materials

may be obtained from a staff prepared to assist you. A lounge area also is located in this building.

Luncheon and dinner are available to Associates daily in The Court, the members' dining room on the ground floor of the Museum of Natural History.

Associates planning a trip to the Smithsonian may write or call for an information packet: Associates Reception Center, Smithsonian Institution, Washington, D.C. 20560; call (202) 381-6264.

If you have misplaced your membership card, the Associate receptionist in the castle will issue a replacement upon presentation of your SMITHSONIAN magazine address label. Membership cards are required for dining in The Court and for discounts in the museum shops.

Regional Program invites 1977-78 cosponsors

Regional activities of the National Associate Program in 1976-77 included exhibits, lectures, educational workshops and performing arts events in Peoria, Milwaukee, Detroit, Seattle, Portland, Denver and Minneapolis-St. Paul. Museums and cultural and scientific organizations interested in cosponsoring regional programs for 1977-78 may write: R. H. Angle, Smithsonian National Associate Program, Room 1201, 900 Jefferson Drive, Washington, D.C. 20560.

Spring Museum Hours

Most museums on the Mall—Arts and Industries, Hirshhorn, Air and Space, Natural History, History and Technology, and the Smithsonian castle—are open daily 10 A.M. to 9 P.M. The Freer, National Collection of Fine Arts, National Portrait Gallery and Renwick close at 5:30 P.M. The Zoo is open daily 9 A.M. to 6:30 P.M. and the Anacostia Neighborhood Museum 10 A.M. to 6 P.M. weekdays and 1 P.M. to 6 P.M. weekends. For information call (202) 381-6264.

Parking for Visitors

Street parking near the Smithsonian complex is difficult. Use of public transportation is recommended. The Air and Space garage, 7th Street and Independence Avenue, S.W., is open daily from 7 A.M. to 10 P.M. Recreational vehicles higher than seven feet are prohibited from garage parking.

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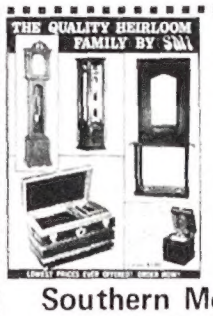

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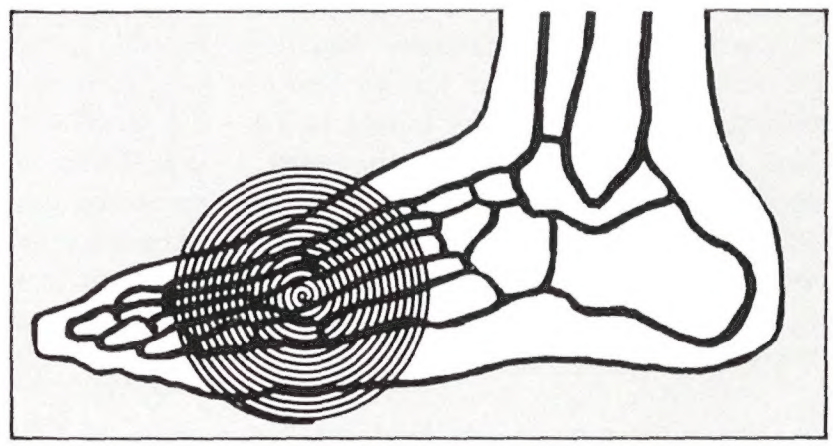

It was the European trip I had always dreamed about. I had the time and money to go where I wanted—see what I wanted. But I soon learned that money and time don't mean much when your feet hurt too much to walk. After a few days of sightseeing my feet were killing me.

Oh, I tried to keep going. In Paris I limped through Notre Dame and along the Champs-Élysées. And I went up in the Eiffel Tower although I can't honestly say I remember the view. My feet were so tired and sore my whole body ached. While everybody else was having a great time, I was in my hotel room. I didn't even feel like sitting in a sidewalk cafe.

The whole trip was like that until I got to Hamburg, Germany. There, by accident, I happened to hear about an *exciting breakthrough for anyone who suffers from sore, aching feet and legs.*

This wonderful invention was a custom-made foot support called Flexible Featherspring. When I got a pair and slipped them into my shoes *my pain disappeared almost instantly.* The flexible shock absorbing support they gave my feet was like cradling them on a cushion of air. I could walk, stand, even run. The relief was truly a miracle.

And just one pair was all I needed. I learned that women also can wear them —even with sandals and open backed shoes. They're completely invisible.

Imagine how dumbfounded I was to discover that these miraculous devices were sold only in Europe. Right then I determined that I would share the miracle I discovered in Hamburg with my own countrymen.

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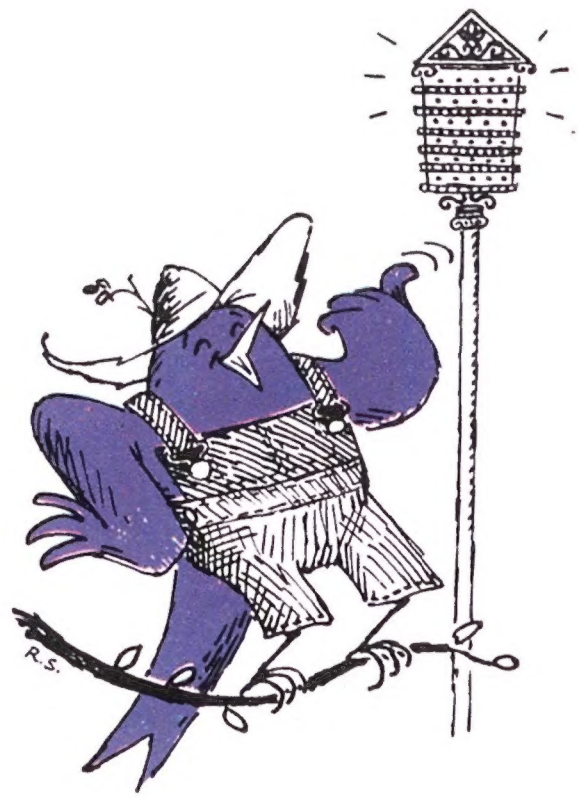
By Mary Hamman

Purple martins, the ingrates, don't read their own paper



Since we dutifully stopped spraying the swamps behind our farm pond with DDT, we have been plagued by mosquitoes, big Jersey-shore types.

"What you need," advised our neighbor, George, a Princeton-trained Bucks County ornithologist, "is a flock of *Progne subris,* purple martins." Martins are not supposed to be finicky about housing, and their dietary habits make them worth pampering. On the wing, George said, they may gulp their weight in insects daily. Flies, dragonflies, beetles, boll weevils and, we were told, mosquitoes—if any happen to be handy—are favorites in the martins' diet.

You don't have to supply birdseed for martins, which saves a lot of mess and bother, because they love to eat living things. Their feet, formed for perching, make them drunken walkers, so they rarely light on the ground. But they are so well streamlined for aerial acrobatics that even their nostrils point upward. There is something appealing about a species that sticks so knowledgeably to its element, unlike walking fish and flying mice and men.

Purple martins—they are not really purple, for the males are violaceous steel blue, the females dingier-looking—love to build nests in protected places. Sometimes they nest in dead pine trees that woodpeckers have pecked holes in—*our* woodpeckers prefer to peck holes in our barn—but they seem to like housing built for them better.

Come spring, martins send out early-bird real estate scouts to evaluate available properties. Flocks fly to places these males recommend. We spent the winter building a house to delight the snobbiest scout. It had 30 apartments, each an eight-inch cube, with entrances two inches in diameter, an inch and a half from the floor, and porches with guard-rails to protect the young. The house is made of kiln-dried poplar with solid oak floor, rainproof roof.

George said it must be 20 feet above ground, in open space at the end of a body of water for martins to swoop over. We cut down several trees near the pond to make an ideal runway. We used a 20-foot cedar post, with metal guards to foil raccoons, snakes and cats. In April it took four men to raise the house in time for the martin scouts. It looked like planting the flag on Iwo Jima.

We settled down, binoculars at the ready, to wait for our martins. April passed, but no martins came. Ditto May and June. George was optimistic. He said the house was too new. The scouts had not found it. Next year, for sure, we'd have our martins.

In the fall we took the house down—a major operation—and though it had had no tenants, sterilized and repainted it. During the winter I read in the *Purple Martin News*—the martin may be the only bird to have a newspaper devoted to its life-style—that they like to eat eggshells. So in the spring I crumbled a hundred dozen shells, saved by eateries in the village, around the pole. Nearby I assembled a pile of straw, twigs, bits of string and mud for the martins to use in their apartments as interior decoration. We followed this complicated ritual for two more years.

Spurned again last spring, we gave up. Let the Midwest go martin-ape. There they even serve a special martin drink, in scouting season, called a purple martini: a normal martini with purple coloring added. The only creatures we know despicable enough to deserve such a concoction are Bucks County's martin scouts. Some Indians used to call the martin "the bird that never rests." I'd change that to "never nests," or maybe better yet, "never wert."

Last July we needed a paper notarized and learned that a nearby farmer was a notary. In his backyard, on a six-foot pole, under a tangle of trees, was a ramshackle birdhouse. Every entrance was crowded with gaping yellow mouths, and every few seconds adult birds arrived with insects. Surely not martins! There's no water! No open ground for a swooping approach! No white paint! No verandas and railings!

"Yep, they're martins," said the notary. "Been coming here for 15 years." We told him about our scientifically built, but scorned, martin house. And told him about our martin newspaper, eggshells, decorating material and our expert, supervising ornithologist.

"Maybe," he said, "Bucks County martins skipped college. Maybe they can't even read. Put your house in the swampy woods. On a short pole. So's you can clean it easy. And don't paint it. Birds don't like paint smell. Don't myself!"

That's what we're doing this year. "You'll get 'em," our notary-farmer said. Seeing as how martin scouts are such rotten real estate agents, maybe we will.

The first name for the martini.
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